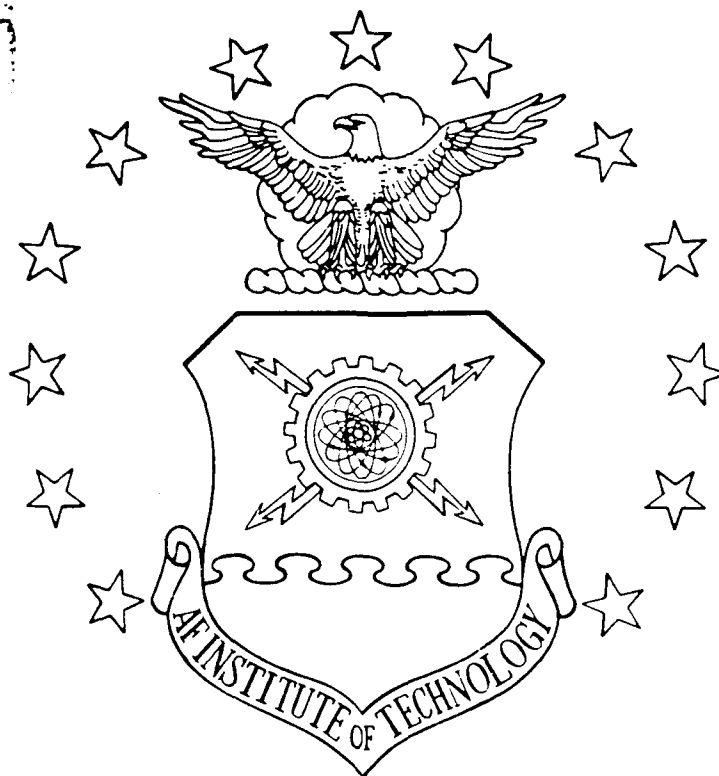AD-A215 581

DEVELOPMENT OF A PERSONAL COMPUTER (PC
SOFTWARE REQUIREMENTS MODEL FOR
SYSTEM PROGRAM OFFICES

THESIS

Derrick M. Richardson
Captain, USAF

AFIT/GSM/LSY/89S-32

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DEPARTMENT OF THE AIR FORCE

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Wright-Patterson Air Force Base, Ohio

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AFIT/GSM/LSY/89S-32

DEVELOPMENT OF A PERSONAL COMPUTER (PC) SOFTWARE

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THESIS

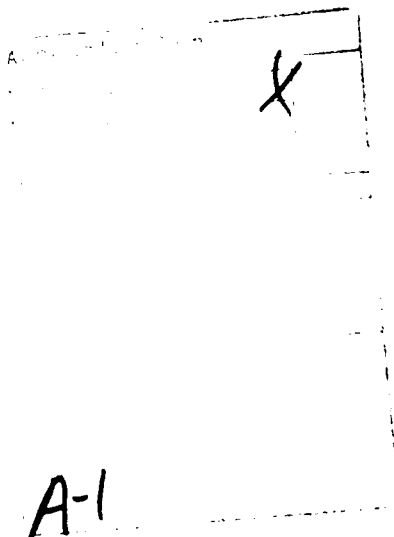Presented to the Faculty of the School of Systems and

Logistics of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Systems Management

Derrick M. Richardson, B.S.

Captain, USAF

September 1989

Preface

The purpose of this study was to develop a personal computer (PC) software requirements model for AFSC system program offices (SPOs). This model assist SPOs in mating PC software requirements to specific software applications. It was necessary in view of the wide use of PCs to enhance SPO productivity and the lack of a comprehensive criteria to assist SPOs in selecting PC software application packages which will provide the most efficient and effective means of automating tasks within their functional departments.

Personnel from the various functional departments within five SPOs representing each of Air Force System Command's five product divisions (one each from Aeronautical Systems Division [ASD], Electronic Systems Division [ESD], Human Services Division [HSD], Munitions Systems Division [MSD], and Space Systems Division [SSD]) were surveyed to aid the development of the proposed PC software requirements model. Although (due to the small sample size) applicability to other similar organizations is limited, the proposed model may prove beneficial in improving the present AF-wide software acquisition process and may result in great cost savings and improved productivity.

In performing this research, I am indebted to many who provided invaluable assistance. I owe special thanks to my

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thesis advisor, Lt Col D. J. McBride whose patience, encouragement, and willing assistance were truly motivational. In addition, I must express my gratitude to Dr Charles Fenno who provided invaluable assistance and many kind words of inspiration. I also would like to thank my parents and fianceé, Denise, for their never-ending prayers and reassurance. And, lastly, I must give all the praise and glory to my Lord and Saviour, Jesus Christ to whom without him, I could not have persevered this endeavor.

<div align="right">Derrick M. Richardson</div>

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Abstract

This research effort was devised to discover whether the development of an alternative PC software requirements determination model for system program offices (SPOs) within Air Force Systems Command (AFSC) might improve their current software acquisition process. In developing this model an understanding of the present methods used to define personal computer (PC) software requirements, along with the current procurement methods employed were examined. The model is designed to match SPO mission objectives and functions with critical office tasks necessary to accomplish these objectives and functions. It then investigates/selects those PC software products which will best support the office task(s). Use of this alternative PC software requirements should able SPOs to better define, justify, and satisfy PC software requirements.

Five research objectives were addressed to accomplish this study:

1. Determination of the effectiveness of currently available PC software applications used to support SPO tasks.

2. Determination of the current processes SPOs use to identify PC software requirements.

3. Determination of the methods SPOs currently use to acquire PC software products.

4. Determination of the effectiveness of present PC software requirements identification and procurement practices.

5. Determination of whether the development of a tailored PC software requirements model for SPOs might improve the PC software acquisition process.

The primary methodology employed consisted of a 29-question survey of 75 personnel assigned to five SPOs (one from each of the five product divisions) within AFSC. This survey explored the PC software applications currently in use, how SPOs determine PC software requirements, how effective are the current requirements determination methods, and how an alternative PC software requirements model might improve the current procurement process.

The Suggested or Alternative Requirements Determination Model was developed from the literature reviewed on information systems and data collected from the survey. The model provides a comprehensive methodology for assisting SPOs in determining PC software requirements. Better determination of PC software requirements should make choosing the right software for the right job an easier task, thereby resulting in enhanced mission effectiveness.

DEVELOPMENT OF A PERSONAL COMPUTER (PC) SOFTWARE REQUIREMENTS MODEL FOR SYSTEM PROGRAM OFFICES

I. Introduction

Overview

This chapter defines the research problem by first describing the current method of personal computer (PC) software acquisition in the Air Force and then explaining the basic approach used to explore the problem of determining PC software requirements in system program offices (SPOs). Specifically, this chapter includes a problem overview, specific research question, basic definitions, research purpose and approach, key assumptions and limitations, research objectives and investigative questions, and concludes with a brief overview of the remaining chapters.

Research Problem Overview

Background

The number of PCs in organizations has been steadily increasing across the U.S. for two primary reasons. First, the rapid advances in microcomputer technology have consis-

tently pushed the PC cost/performance ratio along a 30 to 40 percent price reduction curve each year and are expected to continue at this rate well into the 1990s (9:3-10). Second, more executives are beginning to realize how much this technology can improve their office productivity and potentially give them a competitive edge over their rivals (64:98-103).

For the Department of Defense (DoD), functioning in an era of continued manpower cuts (the notion of "doing more with less") and increased public scrutiny of military management practices, these tools have taken on added significance as DoD organizations search for better ways to increase office efficiency and effectiveness (79:89). Perhaps nowhere is this search more evident than in SPOs, where timely, organized, and accurate information is essential to the success of an acquisition program (87). This increasing reliance on office automation makes choosing the right software for the right job an increasingly important endeavor. To meet this demand for increased productivity, the Air Force is placing greater attention on office automation through the acquisition of inexpensive PCs. These relatively inexpensive, yet sophisticated management tools require software that is both efficient and effective. In other words, to get "the most bang for the buck" from these PC management tools, it is essential that

adequate resources be spent to define software and hardware requirements and to plan the implementation of such systems. Lee states that very little attention has been devoted to establishing a connection between the availability of PC technology and how it should be used by professional workers and managers (57:313). However, often this initial investment in planning is not made as evidenced by a recent study of office management practices. This study suggests two potential hindrances to effective office automation:

1. Organizations, in their haste to acquire PC systems to aid office automation, frequently neglect to adequately define the purposes for which the systems will be used.

2. Such precipitous PC acquisitions, coupled with a lack of user involvement (in the acquisition process) and inadequate personnel training, have greatly contributed to the passive acceptance of these systems by the intended users (22:170-171; 57).

Although the acquisition and implementation of PC systems have (according to various AFSC program managers) increased office efficiency and productivity in SPOs, improper or inadequate planning for these systems has decreased their overall cost effectiveness. Such poor organizational planning in the form of limited information management systems, inadequate information analysis, poor systems development processes, and underestimated system

operation and maintenance costs can easily translate into
increased system life cycle costs. This realization was
further echoed at the 1988 Executive Seminar on Communi-
cations and Computers in Air Force Systems Command (AFSC)
where the following issues were raised in PC systems
acquisition:

> The problem stems from the lack of a cohesive
> framework and planning roadmap to guide Air Force
> information system design, acquisition, and
> implementation. The key factors affecting this
> lack of cohesion are the technology explosion. the
> exponential growth in user requirements,
> ill-defined requirements and technical solutions,
> and a difficulty in focusing programs on mission
> needs. The result has been a proliferation of
> incompatible stand-alone systems, mission support
> deficiencies, a duplication of effort, a waste of
> resources and a loss of credibility (90).

This problem is not DoD unique. Lee in his study of 12
organizations ranging from small businesses to *Fortune 500*
companies, found that merely increasing the presence of PCs
in the office does not guarantee they will be used
effectively (57:313). Young agrees and estimates between 20
and 36 percent of all PCs end up being abandoned by users
due to ineffective use (99:100-114).

In an effort to curtail some of these problems, a PC
system requirements model should be designed to provide the
"cohesive framework" and "roadmap" necessary to assist
organizations in defining PC software requirements.
Currently, the Air Force has two publications which address

PC requirements determination: AFR 700-26 (Acquisition and Management of Small Computers) and AFP 700-30 (How to Determine and Justify Information Systems Requirements in an Office Environment). Both publications offer organizations assistance in determining PC requirements by recommending procedures for system development and user involvement during requirements analysis. However, neither advocates a tailored approach (specifically designing the PC requirements analysis to fit the individual organization) to PC requirements determination. A tailored approach would allow organizations the flexibility to match PC systems to their specific organizational needs. Basically, AFR 700-26 describes the PC systems acquisition process (for both hardware and software), and AFP 700-30 uses a top-down design structure to give organizations a way to identify potential areas for automation. Nevertheless, neither publication provides guidance in determining specific hardware and software requirements. Handy recently developed a preliminary model which maps PC software requirements to Air Force needs (44). This study focuses on extending the model specifically for system program offices (SPOs) within AFSC.

Specific Problem

With the abundance of PC software cools on the market to perform a multitude of tasks, choosing the correct software to automate selected SPO tasks can be a difficult proposition. The problem is there are no comprehensive criteria for assisting SPOs in deciding which software packages to choose in order to provide the most efficient and effective automation of their functional departments. Thus, the research question becomes: *What selection process should SPOs use to acquire the best possible PC software to efficiently and effectively automate selected office tasks?*

Definitions

Application Programs (or Software) - Computer programs used to perform specific user tasks, such as word processing, database management, etc. They may be general-purpose or specifically designed to address unique tasks (30:6).

Requirement - A need for a new or improved way of capturing or processing data, producing information, controlling a business activity, or supporting management. If this need is satisfied, it could potentially increase mission success and/or decrease mission support costs (88:66; 29:1).

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Requirements Determination - The process of using strategies and procedures to evaluate management goals/objectives and behavior characteristics to fulfill a user application need. It involves studying the current information system to discover how it works and where improvements can be made (25:473-496; 88:66).

Software Product - Specifically named application programs like CONDOR, WORDPERFECT 5.0, MathCAD, etc.

Software Type - Categories in which software products may be placed, like spreadsheets, word processors, decision support systems, etc. (44:7).

Appendix A contains a more comprehensive list of terms used in this study.

Scope of Research and Method of Organization

Justification

SPOs, along with other Air Force organizations, currently use the Small Computer Technical Centers (SCTCs) to specify and process PC software requirements. These SCTCs, in addition to managing the software libraries for each major command, also provide Government-owned/licensed software to authorized users upon request and make catalogues of commercial and DoD developed software products available to Air Force personnel (30). What they do not do, however, is match office PC software requirements to a

specific software application. Consequently, according to interviews with various SPO directors from each of AFSC's five product divisions (Aeronautical Systems Division [ASD], Electronic Systems Division [ESD], Human Services Division [HSD], Munitions Systems Division [MSD], and Space Systems Division [SSD]) many SPO organizations have acquired a number of PC software programs only to have them be used improperly or not at all. The results from this study should prove useful in improving the current process of mating SPO PC software requirements to specific software applications.

Research Approach

This study involved a survey of SPO functional department personnel. One SPO from each of the five product divisions in AFSC was selected to participate. The survey was designed to provide supporting evidence for potential improvements to the PC software acquisition process.

Key Assumptions

1. All SPOs use PCs compatible with the systems specified in the Air Force Standard Personal/Small Computer Contract.

2. SPOs surveyed were representative of all SPOs.

3. Persons surveyed were representative of all SPO personnel.

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Limitations

1. Only one SPO from each AFSC product division was surveyed.

2. Not all SPO personnel surveyed know how their departments acquire PC software to automate specific office tasks.

Research Objectives

To assist the development of a PC software requirements model for SPOs, the following research objectives were addressed:

1. Determination of the effectiveness of currently available software applications used to support SPO tasks.

2. Determination of the current processes SPOs use to identify PC software requirements.

3. Determination of the methods SPOs currently use to acquire PC software products.

4. Determination of the effectiveness of present PC software requirements identification and procurement practices.

5. Determination of whether the development of a tailored PC software requirements model for SPOs might improve the PC software acquisition process.

Investigative Questions

The following investigative questions were addressed during the course of this research effort:

1. Who are the users of PC software products?

2.a. What PC software products are SPOs currently using?

2.b. How often are these products used?

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2.c. How satisfied are the users with these products?

3. Which PC software products are the most critical for SPOs?

4. Are current PC software products being used for their intended purposes?

5. Are personally-owned PC software products used to accomplish office tasks? Which ones, and why are they used?

6. Is there a departmental policy establishing a process or method for determining PC software requirements?

7. What guidance do SPOs receive when defining PC software requirements?

8. Who defines SPO PC software requirements?

9. What acquisition methods do SPOs use when purchasing PC software?

10. How effective and efficient are SPO PC software acquisition methods in providing the correct or requested software?

11. Are there alternative methods or improvements which could be made to the current PC software procurement process?

Thesis Organization

The remainder of this study is structured towards answering the investigative questions posed above. Chapter II contains a review of the literature on PC requirements analysis and a brief description of the current PC requirements analysis models (for both hardware and software). The specific methodology used in this research effort is detailed in Chapter III. It describes how the

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survey instrument was constructed and how the data gathered
was analyzed. In Chapter IV, Results and Discussion, the
data gathered from the questionnaire was used to answer the
investigative questions posed in this chapter and to develop
an alternative PC software requirements model. Finally,
Chapter V, Conclusions and Recommendations, summarizes the
research study explaining the rationale for selecting the
proposed SPO PC requirements model over other models. It
also provides recommended areas for further research.

II. Literature Review

Introduction

Office automation can be broadly interpreted as the use of computer technology to perform various knowledge tasks. But it specifically represents the modern method of handling business documents and person-to-person communications. It consists of capital investments in electronic office equipment (like PCs, telefax machines, etc.) connected to a communication network which forms an integrated, multi-functional, electronic office within an organization (95:4). Although much has been written regarding the implementation and use of office automation systems, the area of PC software requirements analysis to support office tasks has received little attention. Various office automation topics, nonetheless, have supplied invaluable information which is deemed pertinent to PC software requirements analysis. This research examined some of the related aspects of office automation such as end-user computing, personal computing, and considerations for PC-based software applications in office automation development. In addition, current PC publications were researched for guidelines to buying PC software, and Appendix B gives ratings of various PC software applications

for the office environment. The findings of this review
follow.

End-User Computing

As the decline in U.S. productivity becomes more
salient, there is an increasing focus on innovations for
business organizations (16:1). This quest for continued
productivity is echoed in such works as The Change Masters
by Kanter (1983), In Search of Excellence by Peters and
Waterman (1982), and the Age of Discontinuity by Peter
Drucker (1978). Drucker understood the importance of
knowledge work in promoting an increase in office
productivity. He said:

> To make knowledge work more productive will be the
> great management task of this century, just as to
> make manual work [more] productive was the great
> management task of the last century (33:290).

Knowledge work includes tasks which involve thinking,
processing information, formulating analyses, making
recommendations, and developing information systems
(25:409). In an effort to increase productivity, knowledge
workers increasingly make use of information technology,
like intelligent workstations, information retrieval,
communications, and decision support systems (16:1). The
effective use of office automation offers management some
unique opportunities for addressing complex productivity
issues facing today's office environment (95:1). An

innovative use of this information technology is *end-user computing*. Leitheiser and Wetherbe define end-user computing as the "use and/or development of information systems by the principle users of the system's outputs or by their [support] staffs" (96:3). End-user computing gives users the capability to have direct control of their computing needs and is steadily increasing in importance for organizations. It is expected to be the fastest growing area of computer use for the coming decade. In the very near future, it is estimated that 50-100 percent of the computer processing power available within organizations (as compared to 15-20 percent for traditional applications) will be used for end-user computing (83:776). This trend is understandable when the advantages of end-user computing are considered. These advantages include:

1. Better and more timely access to information, which means:

2. Improved decision-making,

3. Improved user control and acceptance of information system implementation, and

4. Lower system development costs. (16:1)

In addition, Leitheiser and Wetherbe noted eight reasons why users choose to do their own computing:

1. Users have more control of information system use and development.

2. Lead times for development requests are shorter.

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3. User developed information systems better meet user needs.

4. Services are not available from MIS departments.

5. Users perceive MIS departments are not concerned about their needs.

6. Small applications are not well-suited to MIS department procedures.

7. Users are motivated by a vested interest to learn about computing.

8. Users have more flexibility.

9. Development costs are lower (96:3-10).

However, Davis and Olson are quick to point out the potential risks of end-user computing. These disadvantages are: (1) the risk of eliminating the separate functions of the user and the analyst (as an independent reviewer) in building and using support systems that meet organizational objectives, (2) the limited ability of the user to identify correct and complete requirements for an application, (3) potential for unreliable information systems due to a lack of quality assurance procedures, (4) the risk of developing incompatible systems as a result of non-standard interfaces between organizational departments, and (5) the over-use of private information systems (which may encourage information hiding) when organizational systems may be more appropriate (25:430-431). In view of the advantages and disadvantages delineated above, the key issue for managing end-user

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computing is to maximize its benefits while minimizing its risks (16:2).

Organizationally, there are <u>four</u> important issues in the context of end-user computing:

1. Policy and procedures for microcomputer acquisition and use,

2. End-user software support,

3. Organization of the information center, and

4. End-user satisfaction (25:650).

Microcomputer Acquisition and Use. Parallel with the trend toward end-user computing is a significant shift towards decentralization in the use of information system resources. Although, theoretically, the organization of end-user computing can be either centralized or decentralized, the use of microcomputers (or PCs) has fostered increased decentralization. Their relatively low cost makes it easy for departments or individuals to acquire them within their budget without oversight from upper-level management. These systems bring instant technology and promote user innovation, but (according to Davis and Olson) they can also pose several problems:

1. Acquired microcomputers may be incompatible. This may not be important at first, but with expanded use, there is a need to transfer data and software.

2. The microcomputers may need to access data from a mainframe computer which requires special software and may introduce additional data control problems. An assortment of microcomputers makes this process more difficult.

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3. A variety of vendors for hardware and software complicates maintenance.

4. Difficulties and inefficiencies in training are magnified when there is an assortment of microcomputers and software (25:650-651).

As a result of these problems, many organizations have established policies for microcomputers setting limits on the number of hardware, software, and vendor options. In turn, these options are normally supported by the training, consulting, and maintenance staffs of the information or computer center (25:651).

End-User Software Support. One area of great concern similar to microcomputer acquisition, is the availability of central support for software (especially software other than the standard packages defined in the procurement contract). Because users may develop their own software, procure software applications on their own, or contract with information systems support staffs to procure software packages, many authorities believe this makes adherence to rigid system development life cycle procedures virtually impossible. In particular, continued maintenance of these software packages poses significant problems. Persons responsible for developing or procuring the software may relocate to other positions or organizations, leaving the software without knowledgeable user support personnel. Moreover, vendors may provide upgrades or changes to the

software requiring expertise to install. Factors such as these suggest the need for organizational policy delineating clearly defined roles and responsibilities for end-users and information centers (25:651), as well as standards for procuring hardware and software (49:143). One method, expounded by Leitheiser and Wetherbe, is to define classes or levels of provided software support (see Table 1) [59:339-342]. Davis and Olson aptly describe three advantages of such a policy:

1. Users have the flexibility to experiment with undocumented software packages or write undocumented software programs, but they know up-front whether these experiments will be supported.

2. If users want complete support, they must negotiate the formal organizational review and approval process.

3. Users may buy software which, initially, may not need support, but if (or when) it is needed, they may have to wait and negotiate that support (25:652).

Information Centers. Approximately 80 percent of U.S. business organizations have *information centers* (36:31). The term was coined by IBM in 1976 (98:32), and the concept is based on providing end-users with direct, ready access to computation, consultation, and information processing resources through a central facility. These resources allow end-users to perform their own analysis, develop systems, access data, etc. Specific <u>traditional</u> support includes the following:

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      Table 1.   Classes of Software Support (25:651)
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Class of Support          Explanation

Complete Support          Software developed and
                          documented by information
                          systems staff.

                          Software acquired from outside
                          vendors but reviewed and
                          approved by information systems
                          staff as having adequate
                          documentation and other features
                          for maintainability.

                          User-developed systems that meet
                          standards for documentation and
                          have been reviewed and approved
                          by information systems staff.

Negotiated                Software acquired from outside
Support                   vendors or developed by users
                          that is documented but has not
                          been reviewed and approved for
                          complete maintenance.   Support
                          must be requested and
                          negotiated.

Support Will Not          Software without documentation.
Be Provided               This may also include software
                          written in languages that are
                          not supported by the installa-
                          tion's information system staff.
```

1. Technical assistance in writing
    instructions in a very high level
    language.

2. Education in the use of high-level
    languages and development tools.

3. Assistance in accessing data from a main
    computer.

4. Assistance in debugging programs.

5. Access to reference material on facilities, databases, etc.

6. Administration support for various computing procedures. (25:428)

In addition to the support functions listed above, today's modern information centers provide further assistance to end-users in the following areas:

1. Recommending personal computer purchases.

2. Determining appropriate software packages.

3. Establishing standards for application development.

4. Determining the best tools to accomplish a project.

5. Training end-users to define information requirements and how to use various software tools.

6. Coordinating and storing individual applications and data bases to eliminate redundant efforts (98:34).

Although information center personnel usually act as teachers and consultants to users, they do not develop end-user applications. Instead, they provide users with the knowledge and skills to develop their own applications (98:32). Thus, information centers may have small staffs, but it is vital they have a diverse set and knowledge of hardware and software tools (including mainframe and personal computers), and computing techniques, tactics, and strategies if they are to remain successful (72:71-72).

End-User Satisfaction. End-user computing is important to the development of a PC software requirements model

because identifying these requirements may entail end-user identification and selection of system configuration and operation (44:24). Consequently, an examination of end-user computing satisfaction may be beneficial in determining why certain PC systems and configurations are judged better than others. Doll and Torkzadek compared traditional and end-user computing to discover a way to measure end-user computing satisfaction. They discovered <u>five</u> components of end-user system satisfaction. They are:

1.   Content,
2.   Accuracy,
3.   Format,
4.   Ease of Use, and
5.   Timeliness of information (32:270-272).

In a study of 12 business organizations, Dennis Lee discovered some very positive trends in end-user computing satisfaction. He found users were, generally, satisfied with their PCs and sought other users as key sources for help in application development and in determining system configurations. He also examined the implementation of PC-based systems in two commercial product divisions to find out whether better system use resulted from increased user planning. Although both divisions were satisfied, the division employing greater user planning was judged much more productive (57:321-322).

Personal Computing

One of the main problems facing office management departments pursuing increased automation is ascertaining the proper role (requirements analysis) of personal computers in the organization to ensure end-users needs are met (58:1). In fact, a recent study of 12 organizations on PC usage (ranging from small businesses to *Fortune 500* companies) revealed two key findings. One is that the most important reason for using PCs is to assist various professional (knowledge) work tasks. The other is the challenge for management to find the most effective and efficient way to integrate this technology into the workplace (57:324).

One way to do this is to employ a concept called *personal computing*. *Personal computing* refers to "the use of computer resources by an individual to carry out his or her job" (58:1). The idea is to give the individual managers the flexibility to use the PC in the manner which best supports his/her job. This decentralization makes the manager responsible for using and manipulating the right data to achieve the desired management result(s) [58:11]. However, the difficult task becomes: 1) what data to select and 2) what is the best way to manipulate the data. This research concentrates on the latter by trying to help the

SPO manager select the most appropriate PC software tools to help him/her achieve their management objectives.

Centralized vs Decentralized Control. Because personal computing systems are generally not expected to be used by an entire organization, either centralized or decentralized control practices may be used. In fact, the original concept of the information center assumed centralized facilities would be used to provide the necessary tools for individuals to develop their own computing applications. However, the trend in recent years has been to employ a decentralized structure--thus the popular connection of personal computing with personal computers. Lehman believes the reason for this trend of decentralization is two-fold. One is economic because it is deemed more cost effective to have each manager or department be responsible for acquiring and maintaining their respective personal computing system. The rationale here is that because information is primarily used by a single individual, any problems encountered with quality or integrity have limited impact upon the whole organization. This means large investments in reliable hardware and software and in security and control measures (indicative of organizational computing systems) need not be made for personal computing systems. The second part is political in that if an organization decides on a centralized structure for their personal computing

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operations, it implies submission by the individual managers to controls characteristic of organizational computing systems (58:6-7).

Lehman aptly points out that the philosophy behind decentralized control and decision-making (accompanying recent trends in organizational structure development) is that middle-level managers should be held accountable for the results of their operation. Affording them the opportunity to achieve those results in whatever manner best fits their operation will produce better decisions and higher motivation (58:5). Robert Anthony also supports this view, stating that most organizations have discovered decentralization of management decision-making leads to better decisions and increased productivity (given proper control and motivation) over that of centralization (3). It only makes sense (given the potential for misuse will have little impact upon the entire organization) to give the manager responsible for the results the authority over how best to achieve those results.

Scope of Responsibility. Just because an organization chooses to use personal computing systems does not necessarily eliminate the need for support personnel like system analysts and data processing specialists in personal computing projects. It is highly unlikely that individual managers (as a whole) will have the necessary technical

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skills to select hardware and software or to develop and implement complex applications. They will still require technical advice to review requirements and proposed solutions and technical assistance to implement and maintain the system (58:11).

However, there is a change in the level of responsibility. In personal computing, it is the owner of the system who is accountable for the results and any problems which may arise from the use of that system--the MIS department is <u>no longer</u> responsible. Lehman summarizes this difference stating:

> If the equipment is not suitable for the task, the manager who owns the [personal computing] system is responsib? not the MIS department. If the system produces wrong results, the manager who owns the system is responsible, not the MIS department. If, due to carelessness about backup, a year's worth of data is lost and the department suffers severe financial problems, the manager who owns the system is responsible, not the MIS department. (58:12)

Of course, no one wants these types of things to happen, but the risk of such is inherent when using a personal computing system. The key to avoiding these kinds of problems is to ensure the MIS department's role is shifted to one of education (58:12). By organization-level management stressing the need for individual managers (who use personal computing systems) to seek educational assistance from the MIS department during the early stages of system/application

development and implementation, these problems may be
prevented.

Considerations for PC-Based Software Applications in Office Automation Development

Defining Software Requirements. Although there seems
to be very little information specifically addressing the
process of defining PC software requirements, there is
information addressing information system requirements
determination which can be applied to software. The
discussion which follows highlights that information which
is deemed most applicable to PC software requirements
determination. Presented first is the support rationale for
software requirements determination, followed by strategies
for consideration. In addition, Appendix C provides a brief
overview of some of the more widely known methodologies used
to determine information system requirements. As previously
defined in Chapter I, *requirements determination* is the
process of using strategies and procedures to evaluate
management goals/objectives and behavior characteristics to
fulfill a user application need (25:473-496).

Support Rationale. The requirements phase of the
software life cycle precedes the design of the software. It
includes an analysis of the users' needs along with a
specification of both the functional and non-functional
requirements (i.e., cost of the software, compatibility with

the present hardware/software configuration, etc.) of the
system software. To carry out these activities, the analyst
must have a clear understanding of the environment in which
the software will function and its intended purpose. The
focus of requirements determination should be on *what* you
want the software to do, as opposed to *how* you want it done
(13:82-83). Because quite often the benefits of various
software applications are not fully realized, an effective
requirements determination analysis is vital to assist
organizations in fulfilling their automation needs (72:74).
The importance of requirements analysis was reiterated by
the DoD's Defense Science Board which said, "The toughest
part of the problem for software [selection and design] is
defining the exact requirements" (70:72). AFP 700-30
describes reasons for the limited effectiveness of
information technology--which are also applicable to
application software. The reasons given are listed below:

1. Many times information technology is acquired
   without establishing clear objectives for having
   it. The technology will most likely yield limited
   results when it is procured without first
   identifying clear objectives.

2. Poor, previously established, procedures are not
   streamlined prior to implementing new information
   technology. Thus, these poor procedures are done
   better, but still very inefficiently.

3. Because there is no easy methodology for
   requirements determination, many managers believe
   the analysis is too complicated. As a result, some
   managers do not even consider the possibility of

using information technology to improve their
office productivity.

4. Many managers who are aware of the various
information technologies and could take advantage
of them, do not because they have difficulty
justifying their requirements. Consequently, if a
requirement is not justified, it must not be valid.

5. Some managers are too quick to find the technical
solution before they fully understand the
requirements. This tendency "to attempt problem
solution before problem definition" is becoming
more prevalent in the information technology world
(29:1-3).

Requirements Determination Strategies.

Undoubtedly, requirements determination is essential to

selecting the appropriate software application. However,

there are obstacles to performing requirements determination

analysis. Davis says there are four major reasons it is

difficult to specify a complete set of requirements. They

are as follows:

1. The constraints on humans as information
processors and problem solvers. [As
information processors, humans have
limitations in terms of their memory
capacity, are biased in their selection
and use of data, and use bounded
rationality when making decisions.]

2. The variety and complexity of information
requirements.

3. The complex patterns of interaction among
users and analysts in defining
requirements.

4. Unwillingness of some users to provide
requirements (for political or behavioral
reasons). (24:4-9)

The difficulties delineated above suggest the need for several general strategies of requirements determination. Selecting the appropriate strategy should be based on the contingencies which apply to a specific case. The *requirements determination strategy* is defined by Davis as "the general approach to obtaining requirements" (24:4).

Davis describes four strategies for information requirements determination:

1. Asking directly,
2. Deriving from an existing information system,
3. Synthesizing from characteristics of the utilizing system, and
4. Discovering from experimentation with an evolving information system. (24:12)

The first three strategies are not only applicable to determining organizational information requirements, but software applications as well. (The fourth strategy is deemed applicable to a lesser extent.) Davis further points out that these strategies need not be used independently (24:12). In fact, a 1977 study by Munro and Davis found analysts and users preferred a mixed strategy to define their information requirements (68:55-67). Appendix C provides a brief discussion of these four strategies.

Selecting a Requirements Determination Strategy. Selecting a strategy for determining information requirements is contingent upon the environment in which the requirements determination process is conducted. The

approach to selecting an appropriate strategy involves determining the level of uncertainty in the requirements determination process and consists of five basic steps. These steps represent a series of uncertainty evaluations to establish a basis for selection (24:19-24). The steps are summarized by Davis in Table 2. However, again, the analyst need not choose one of these methods exclusively. He/She may decide a combination of strategies is most appropriate for determining requirements (25:497).

Requirements Determination Methodologies. This section discusses some of the more prevalent information requirements determination methodologies used in today's office environment. Although every methodology has its own unique features, the one thing they all have in common is *fact-finding.* It is essential for the analyst to acquire all pertinent facts about the system/application requirements as quickly and as accurately as possible. These facts should tell the analyst "why" and "how" certain activities are performed and "what" data is used in performing these tasks (88:73-85). Timing, frequency, and volume of activities are also important data to gather (88:68-70). Used properly, the four fact-finding methods of **interview, questionnaire, on-site records review,** and **direct observation** will furnish this necessary information (88:86).

Table 2. Steps in Selecting a Strategy and Methods for Determining Information Requirements (24:20)

1. Identify those characteristics of the four elements in the development process that affect uncertainty in the determination of information requirements:

    - Utilizing system
    - Information system or application
    - Users
    - Analysis

2. Evaluate the effect of the characteristics of the four elements in the development process on three process uncertainties:

    - Existence and availability of a set of usable requirements
    - Ability of users to specify requirements
    - Ability of analysis to elicit and evaluate requirements

3. Evaluate the combined effect of the process uncertainties on overall requirements uncertainty.

4. Select a primary strategy for requirements determination based on the overall requirements and level of uncertainty.

    Uncertainty   *Strategy*

       Low   Asking directly
        ↑   Deriving from an existing system
                  Synthesis from characteristics of
        ↓   utilizing system
       High   Discovering from experimentation

5. Select one or more methods from the set of methods to implement the primary strategy.

In selecting a methodology, it is also important to recognize that methodologies vary in the amount of structure they provide. Some may provide a good conceptual structure,

but furnish very little process and documentation structure;

others may supply detailed structure for all tasks. The

degree of structure importance depends on the situation.

For example, analysts and users with little experience and

know-how may want a great deal of structure. On the other

hand, experienced analysts and users who are familiar with

the application domain, may find a detailed structure a

frustrating road block (25:479).

According to Davis, a methodology for requirements

determination should be able to accomplish the following:

1. Assist the analyst in formulating the problem
   space.

2. Assist in searching efficiently within the problem
   space by aiding requirements discovery and in
   overcoming short-term memory limitations in human
   information processing.

3. Assist in overcoming biasing factors such as
   recency, concreteness, small sample sizes, and
   valuing unused data.

4. Aid in overcoming user or analyst prejudices, lack
   of training, customs, and attitudes.

5. Provide assurance that requirements are complete
   and accurate (25:479).

Appendix D contains descriptions of some of the more widely

recognized requirements determination methodologies which

adhere to the above criteria. They are useful in assisting

organizations to design their own requirements determination

methodology.

Deciding Which Tasks to Automate. The dilemma of
deciding which tasks to automate may sometimes be as
difficult a proposition as selecting the best strategy/-
methodology for defining requirements (55:8). This decision
is very important since--due primarily to time and funding
constraints--it is virtually impossible to automate every
office task. Consequently, managers must not only define
but prioritize those tasks most coveted for automation.
Kumar and Welke identified two factors which can signifi-
cantly alter the task selection process. These factors are
viewpoint differences between the system designers and the
end-users. Kumar and Welke were able to show that during
information system development, system designers pay more
attention to technical and economic values over socio-
political-psychological values like user satisfaction. The
researchers believed this outcome was a result of the
organization's reward structure being tied to quantifiable
economic and technical criteria (like cost, schedule, and
performance). From management's perspective, economic and
technical values are directly measurable, whereas user
satisfaction values are not (55:8-10). Thus, depending on
the organization's or department's perspective, the priority
ranking of different tasks for automation may vary a great
deal from one department to another.

Managing Requirements Review and Selection. Before any requirement is implemented, someone or some group of people must decide whether it should and can be implemented. This decision to accept or reject a request can be made in a number of ways by various members of the organization. One of the more common ways to review and select a requirement for implementation is by committee. Lucas examined three committee types for this purpose: 1) *information systems committees*, 2) *user-group committees*, and 3) *steering committees*. Some organizations decide a committee of managers and analysts from within their information systems department should be responsible for reviewing and selecting requirements for implementation, hence the *information systems committee*. It works well when there are many requests for routine applications or maintenance (upgrades, debugging, etc.) on existing products. Other organizations choose to allow the actual users to define and select requirements for implementation; they are *user-group committees*. In this way, departments form their own review/selection committees. However, this process can mean wasted resources due to the lack of coordination with other organizational departments. *Steering committees* are primarily composed of key managers from the various organizational departments, along with members of the information systems group. These individuals have the

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responsibility and authority to decide which requirements are most important to achieve mission objectives and goals (88:47-49). This method appears to be the best of the three since it approaches information requirements review/-selection as a management function. Decisions are made based on cost, compatibility/interoperability, and overall benefit to the organization.

User Involvement. Key to implementing automated office tasks is to seek user involvement in the software/-information system selection and design process, especially during requirements determination. *User involvement* is referred to as "participation in the system development process by representatives of the target user group" (48:587). As Nutt notes, users should be involved in the planning and defining of requirements to ensure requirements are understood and have been defined as necessary to meet their office automation needs (71:139-140).

The basic objective in implementing an information system or software application, as expressed by Vessey and Tait, is to enhance task performance, and successful implementation only happens when users are satisfied with the system (94:10). Empirical evidence supporting this hypothesis was obtained from a recent study (1986) by Baroudi, Olson, and Ives. It showed that user involvement during information system development will enhance system

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usage and improve user satisfaction (6:586-601). The implications of these results are significant for PC software applications in that they support the idea that users' participation in the requirements determination process and the acquisition or development process for PC software applications may yield the following results:

1. Users may gain more self-esteem from sensing they have some control over the process.

2. Participating in the acquisition or development process may be perceived as challenging and intrinsically satisfying.

3. Better solutions to office information problems may be sought since the users know more about their present operations than the computer department staff.

4. Users may be less resistant to changes in information requirements since they are more knowledgeable and better trained in the use of their respective software applications (62:111).

Validation of Software Requirements. Once software requirements have been identified to automate a specific task, they must be validated. *Validation* is the process of evaluating software requirements to ensure they comply with the intended office (knowledge) task. This is done to provide assurance that offices will acquire or develop software products capable of performing the required operations necessary to assist personnel in fulfilling their overall office duties. Valuable time and money can be saved

by having well-defined software requirements with which to evaluate proposed software applications (12:75-76).

Acquiring PC software. A 1987 report by the DoD's Defense Science Board recommends the DoD buy more commercial software since it is "the cheapest and fastest way to acquire software" (70:72). However, with the enormous amount of PC software on the market today--over 10,000 commercial programs as of 1987 and growing exponentially--care should be taken when acquiring these products (69:114).

To begin, in an effort to assist users in selecting among the tremendous array of software products, ranging from word processors to spreadsheets to program management packages, a number of distribution sources now exist. These sources fall into five main categories:

1. Retail stores,
2. Mail order companies,
3. Consultants,
4. Software companies, and
5. Other users (21:104).

Each of these sources has pros and cons which the user and/or buyer need be aware of. A brief overview of these advantages and disadvantages is given in the following paragraphs.

1. **Retail stores** typically sell more hardware than software because of the higher profit margins attainable and fewer "after-sale" complications. The biggest advantage of buying from them is service. There is reassurance in

knowing there is someone locally available to answer questions or address problems which may arise. However, their disadvantages are primarily two-fold: 1) they are usually the most expensive source, and 2) they primarily carry best-selling programs, which may not exactly fill the users' needs. Retail outlets are generally a good choice for new users (69:114).

2. **Mail order companies** usually sell software at 20 to 50 percent below the retail price (Needle:114) by cutting profit-making middle men out of the distribution chain. They focus efforts on offering quick service, low prices, useful advice, and customer convenience (56·13; 61:78). They normally carry a broad selection of software, including the best-selling products. They also offer a good way to find "add-on" and accessory software programs developed by small companies who have low advertising budgets Nonetheless, buyers should be wary of giving their credit card numbers to strangers, varying shipping and return policies, and companies not shipping the most current software version due to having large inventories. For the user who knows exactly what he/she wants, this is a good option (69:114).

3. **Consultants** can be very beneficial where there are highly specialized needs which require customizing or tailoring the software (69:115). For these needs, a new kind of dealer has emerged called a value added dealer (VAD)

or value added reseller (VAR). They are basically consultants who can assist personnel in selecting the most appropriate software, tailor it to meet users' specific applications, train the personnel to use it, and provide follow-up support services (21:109). The obvious advantage to using consultants is they can save users time in researching how to best tailor the software to perform their specialized task. The disadvantage is the cost which will usually be around $100 per hour and up for first-rate consultants. As well, prices for continued technical support are also high (69:115).

4. **Software companies**, which sell directly to users, are usually small firms which do not have a distributor. In an effort to follow in the footsteps of such companies as Borland International (who became one of the largest software firms in the U.S. by direct sales), numerous companies are choosing this business strategy. Because of the intense competition among these firms, the advantages for the user are low prices and eager support. Still, not all companies have toll-free support lines, and others have only limited hours of operation (69:115).

5. **Other users** include user groups, mail order buying clubs, electronic bulletin boards, and software catalogues. These sources provide the various forms of shareware and public domain software (or freeware, as it is now commonly

known). According to software analyst David Needle, "there are literally thousands of public domain and shareware programs ranging in price from free to less than $100." Public domain software is non-copyrighted, non-copy protected software programs which have been made available by the author for public use at no cost (except for the nominal fee user groups sometimes charge for finding and shipping the program). Shareware, on the other hand, is that PC software which is readily available to the public for a trial period. After this period, a small donation is requested by the author if the program proves useful to the user. Practically every product category is represented by public domain software. Various electronic services like CompuServe (69:115) and the DoD's own Defense Data Network (DDN) grant easy access to these PC programs. Also, some companies provide catalogues and low-cost package deals on groups of public domain software (69:115). In fact, the Air Force has its own catalogue of user developed PC software (including such well-liked programs as Chart and TDY) to encourage sharing of programs Air Force-wide (30:8). The advantage of this "other users" software source is the extremely low price. However, there are several drawbacks:

1. Since this is not name-brand software, there may be problems locating the author if a problem occurs,

2. Sorting through the volumes of programs can take an inordinate amount of time, and

3. On occasion, some malicious person will put a virus or destructive bug in a public domain software program (69:115).

These difficulties have been echoed in telephone interviews with various AFSC communications-computer systems officers (CSOs) who gave three fundamental reasons for the lack of use of these software sources. They are listed below.

1. Personnel either do not know or do not want to know what is available in freeware or public domain software because they feel more comfortable with commercially available software products.

2. The available freeware or public domain software does not meet the full needs of the user.

3. Locating the appropriate software is a very tedious process.

Moreover, it is imperative that investigative research be done prior to the software purchase to avoid the many pitfalls which beset a number of users/buyers (69:114). Some of the more common traps are as follows:

1. Acquiring software which is incompatible with the existing hardware.

2. Purchasing software from small discount dealers who do not stock the latest software versions.

3. Inadequate software support is provided to address problems encountered by the user.

4. Acquiring software before trying it out or making sure it will meet the users' needs.

5. Procuring software or new/upgraded software versions which are incompatible with the existing software (e.g., old files requiring wearisome conversion procedures to utilize the new software) [21:106-113].

Table 3. A Buyers' Guide for Software
(21:109; 8:83)

Before You Buy

1. Find out the product's suggested retail price.

2. Next, find out about the level of vendor support and its cost. (If the mail order firm has a toll-free number for technical support, buying from a retailer to get this support may not be necessary.)

3. If a dealer wants to sell the product at retail, ask him why you should buy the product from him over a discount mail order firm.

4. If the retail dealer says they provide support for the software, ask exactly what this support entails (i.e, What is the warranty return period?, Does the retailer act as a liaison between you and the software manufacturer?, How long does this support last?, etc.).

5. A retail purchase may be beneficial if you can get a 6-month comprehensive support package. But don't take this offer blindly; do research beforehand, and get guarantees in writing.

6. Whenever possible, try before you buy. Put the software through its paces and read the manual.

7. If you can't try it yourself, ask user groups or bulletin board callers who have worked with the software to provide advice.

8. Don't buy copy protected software. (It has been known to create quite a few problems, especially hard drive failures.)

9. Consult the various reviews in trustworthy computer magazines before buying software or software upgrades.

Caruso has devised a useful checklist to help the user avoid these pitfalls. The checklist is found in Table 3. Perhaps one of the best ways to avoid these various dangers is to carefully read the periodic software reviews presented in leading computer magazines like PC Magazine, Byte, PC World, Compute!, and Personal Computing. These publications provide analysis and ratings of the products in virtually all aspects, from technical design specifications to user-oriented features and applications.

Summary

The literature review explored some of the key aspects of end-user computing, personal computing, and considerations for PC-based software applications in office environments.

As the fastest growing area of computer use, end-user computing offers considerable benefits. Among them are improved decision-making, better control and acceptance of information system implementation, and lower system development costs--all resulting from better and more timely access to information. Along with this growth of end-user computing has been a trend toward decentralization in the use of PCs. This trend has raised considerable concern for improved levels of software support and end-user satisfaction. The use of information centers may hold the key for

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providing guidance in the development and management of PC software applications for end-user computing.

The literature involving personal computing supports the idea of giving individual managers the flexibility to use PCs in the manner which best suits the office task(s). Again, decentralization is the essential aspect of this philosophy since localized control of PCs is thought to foster better management decisions and increased productivity.

Developing the capability to determine PC software requirements should be the primary consideration given to acquiring PC software applications by organizations. The premise is that one must first have a firm understanding of the organizational objectives and office tasks necessary to meet those objectives before selecting a PC software application. In this way, organizations should be better able to match PC software products with their intended office task(s). Several strategies and methodologies for determining PC software requirements may be used. Appendices C and D give explanations of some common requirements determination strategies and methodologies. The strategy/-methodology employed depends upon the environment in which the requirements determination process is conducted. Deciding which tasks to automate is also very important since, due to time and funding constraints, it is almost

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impossible to automate every task. As a result, organizations must also prioritize tasks for automation. Before purchasing PC software, prior consideration should also be given to the distribution sources. These sources, which include retail stores, mail order companies, consultants, software companies, and other users, all have pros and cons which organizations should be aware of. The checklist in Table 3 provides helpful hints for making PC software purchases. Appendix B provides brief descriptions of the top-rated PC software products in the application categories most common to the office environment.

III. Methodology

Introduction

This chapter focuses on the approach used to answer the investigative questions and research objectives posed in Chapter I. Discussed are the target population, the kind of data collected, and the methods of data analysis.

Specifically, answers to the investigative questions were used to develop two PC software requirements models. These two models are briefly described below:

1. The Explanatory or Descriptive Model. This model provides an explanation of the way SPOs actually determine the need for and acquire PC software.

2. The Suggested or Alternative Model. This is the model proposed for SPOs to use when defining PC software requirements and procuring PC software.

Although each of the above models will be discussed in greater detail in Chapter IV, Results and Discussion, the methodology used in this study is instrumental to the explanation and development of these models.

General Method

A total of 75 personnel assigned to five SPOs within AFSC were surveyed to determine what PC software applications SPOs currently use, how they determine PC

software requirements, how effective is their current method, and how a tailored PC software requirements model might improve the current procurement system. One SPO from each of the five product divisions within AFSC was selected--one each from Aeronautical Systems Division (ASD), Space Systems Division (SSD), Electronic Systems Division (ESD), Human Systems Division (HSD), and Munitions Systems Division (MSD). Table 4 shows the respective sizes of the SPOs surveyed (in terms of assigned personnel) for this study. Personnel surveyed within these SPOs represented each of the functional departments typically found within an

Table 4. SPO Size in Terms of Personnel		
Aeronautical Systems Division (ASD)	=	268
Space Systems Division (SSD)	=	175
Electronic Systems Division (ESD)	=	125
Human Systems Division (HSD)	=	172
Munitions Systems Division (MSD)	=	166

AFSC SPO. Figure 1 shows the number of survey respondents from each product division, while Figure 2 shows the percent responding by product division of the total surveyed.

AFSC SPOs were chosen as the target group primarily because of their functional diversity (many different
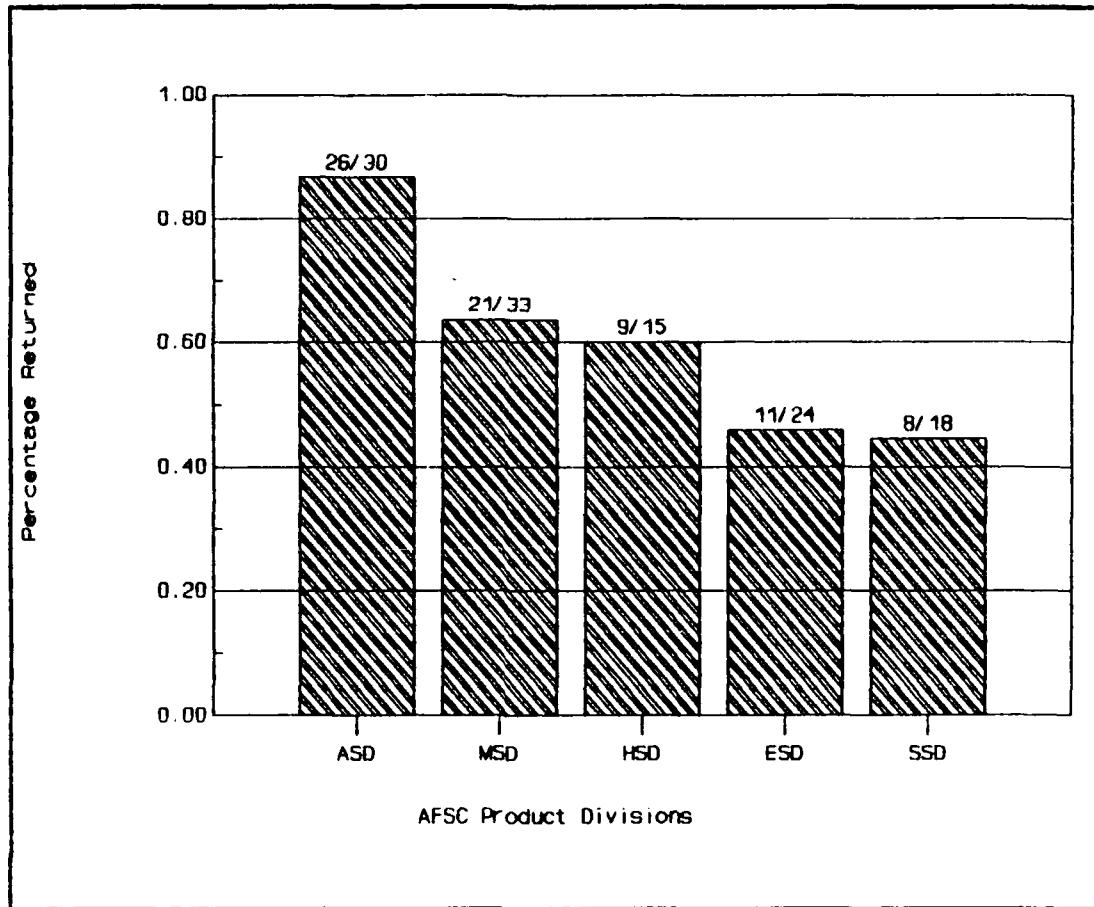
Figure 1. **Number of Surveys Returned by Product Division**

knowledge tasks) and great importance to our nation's development of research and development weapon systems. Having limited personnel to perform a number of diverse and important tasks makes SPOs prime targets for office automation. In an effort to automate these various work tasks, PCs have become common-place in SPOs, thus making selection of the appropriate PC software a must for effective and efficient office automation.

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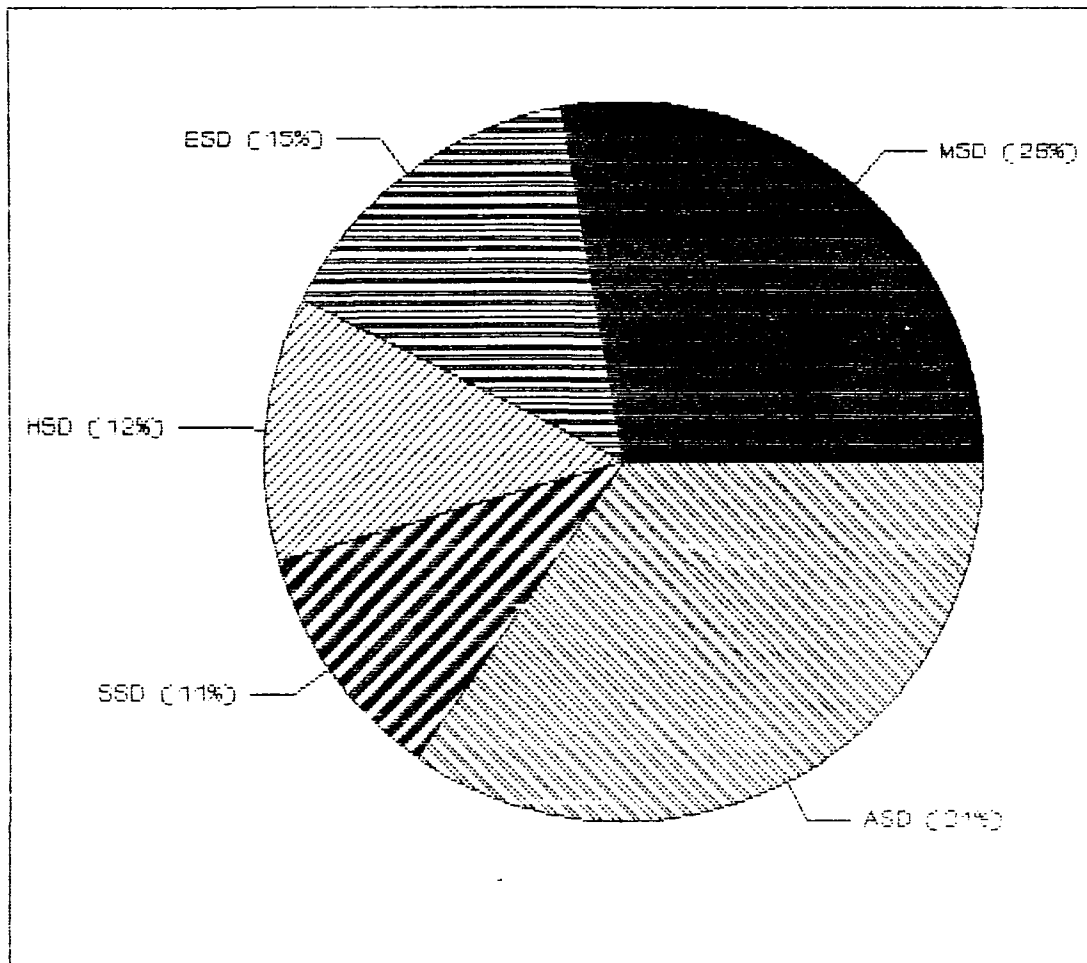
Figure 2. Percent Responding by Product Division of Total Surveyed

Types of Personnel Surveyed

Primarily, the individuals surveyed fell into one of three categories: *managers*, *users*, or *both*. *Managers*, branch chiefs (or equivalent) and above, were surveyed because they were deemed to be in the best position to explain how their department's software is procured. These individuals were categorized as heading their office or

department and having the authority to validate subordinate initiated software requirements. *Users* (individuals within a functional office or department who use PC software to accomplish office tasks) were surveyed since they could best indicate how well the software supported their office tasks. The *both* category was assigned to those persons who use PC software in the accomplishment of office tasks and also have some authority to validate software requirements. Proportions of personnel surveyed by management level are shown in Figure 3. Table 5 further identifies the number of military and civilian respondents at each management level. Overall, 35% (26/75) of those surveyed were civilian and 65% (49/75) were military. Table 6 shows the number of military and civilian personnel surveyed by grade/rank.

The number of surveys mailed was based on the number of functional departments (i.e., engineering, program control, etc.) within each SPO, with three surveys provided for each department. The deputy SPO director then gave each functional department three questionnaires with instructions to distribute one to a middle-level manager (branch chief or higher) and the other two to lower-level personnel.

A cover letter, addressed to each deputy director, was included with each package of surveys; it contained a brief explanation of the survey's purpose along with directions for distribution and return (see Appendix E). A cover
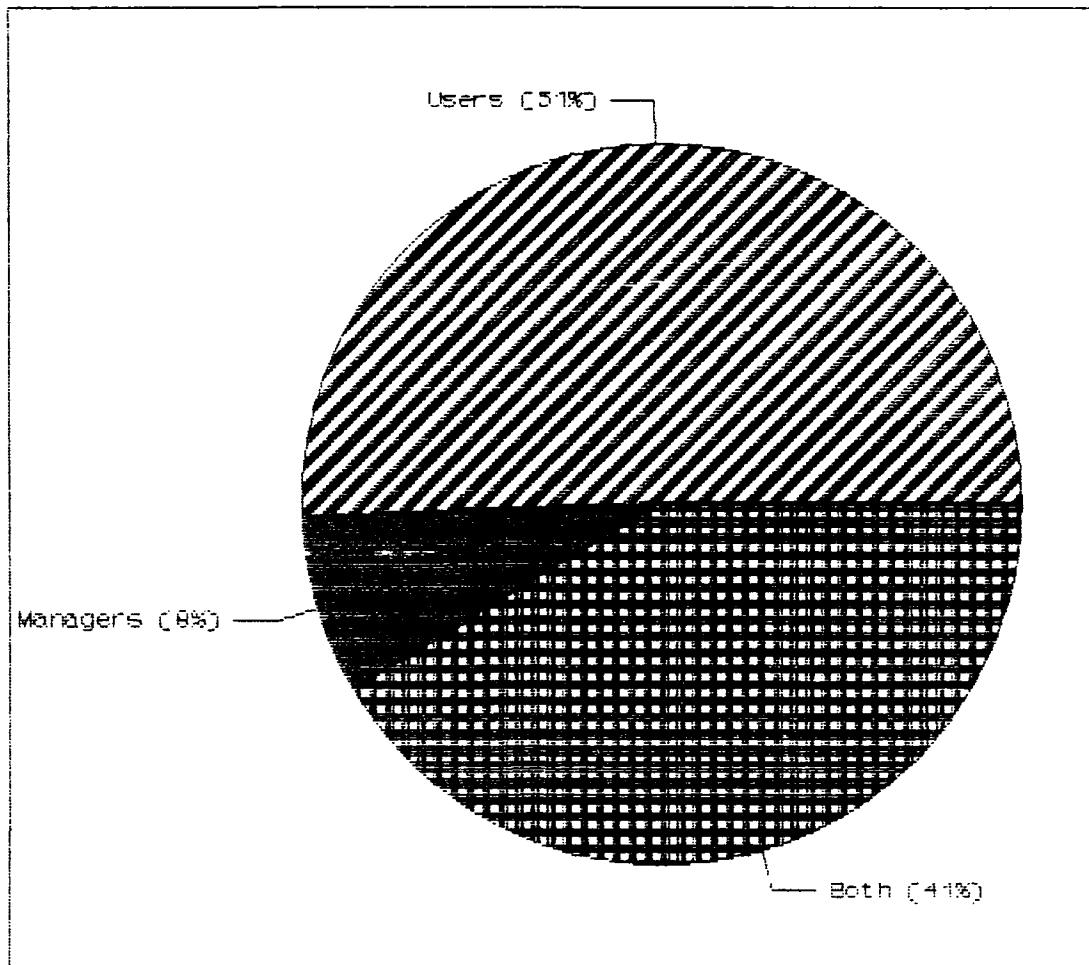
Figure 3. Classification of Survey Respondents by Management Level

letter was also addressed to each of the actual survey
participants. It provided a brief explanation of the
research effort, the benefits of the research with which the
participants could identify, and the importance of their
participation to the study's success (see Appendix F). In
addition, each survey included an instruction sheet (see
Appendix G) which described the research questions the

Table 5.	Classification of Survey Respondents by Management Level and Civilian/Military Status		

__Military__	__Civilian__	__Total__
Users = 32	Users = 6	Users = 38
Managers = 4	Managers = 2	Managers = 6
Both = 13	Both = 18	Both = 31
--	--	--
49	26	75

survey intended to address, the approximate amount of time the questionnaire would take to complete, and the various question response forms included (i.e., multiple choice, rating scale, etc.).

Survey Method and Design

An Air Force Manpower and Personnel Center (AFMPC) approved survey was used to gather the data for this research effort. The survey was designed to collect information in the following research areas of SPO PC software requirements determination:

1. How effective and efficient is SPOs' use of PC software?

Table 6. Number of Civilian and Military Personnel Surveyed By Grade/Rank

Civilian			Military		
GS-7	=	3	E-6	=	2
GS-12	=	4	2nd Lt	=	5
GS-13	=	8	1st Lt	=	13
GM-13	=	4	Captain	=	15
GM-14	=	6	Major	=	5
GM-15	=	1	Lt Col	=	9
		--			--
		26			49

2. How are PC software requirements currently determined in SPOs?

3. How effective are the processes SPOs currently use in determining PC software requirements?

4. Is there a better process SPOs can use to determine PC software requirements?

The survey was constructed in accordance with Dillman's *Total Design Method (TDM)*. *TDM* is a method developed to assist researchers in constructing mail and telephone surveys. It is designed to provide responses of high quality and enhance the overall response rate. The *TDM* approach is predicated on the notion that people need to be convinced of two things before being willing to participate in research: 1) that an important problem exists which they can identify with and 2) that their help is required to find an appropriate solution (31:161-163). Because this approach relies on personalization of the implementation process

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(31:163), various SPOs, from each of the five AFSC product
divisions, were contacted by telephone until one SPO from
each was found that felt the research was important to their
organization and were willing to be participants.

Before beginning construction of the survey, specific
research areas (as previously cited) requiring information
were identified. Then potential survey questions were
drafted to collect the required information. These
questions were formulated with consideration of the four
major decision areas: 1) question content, 2) question
wording, 3) question response structure form, and 4)
question sequence (35:207). In this manner, a variety of
dichotomous, multiple choice, rating scale, and open-ended
questions were developed to assist answering the investi-
gative questions presented in Chapter I. (See Appendix H
for a sample questionnaire). This combination questionnaire
was devised to increase respondent participation by
providing a variety of response forms (23:158-162).

To provide a systematic method for data collection, the
survey was divided into four parts. The first section
contained demographic questions, addressing such things as
job position, grade/rank, SPO functional area, and duties
performed. These questions were useful in determining
patterns of response based on demographic factors. The next
section consisted of questions regarding SPO members' use of

Government-owned office PC software in performance of their duties. These questions were essential to establishing the present environment of PC software applications in SPOs. The third section focused on the use of members' personal PC software to accomplish work-related tasks. In this manner, it was possible to discover whether the currently available PC software was sufficient to accomplish office tasks. The last section addressed the ways different functional departments actually acquired PC software tools. This was done to gain further insight into the way SPOs presently address PC software requirements.

The questionnaire was then reviewed by several faculty members and tested using nine personnel with recent SPO experience. This was done to validate the questions asked of respondents and to insure their effectiveness. Corrections were made following the test, and the questionnaire was again tested using three additional SPO personnel to insure it would provide the type of data the researcher intended. Failure to *test-revise-retest* is one of the major reasons, according to Emory, why poor survey results are obtained (35:207).

Preliminary Data Collection

Of the 120 questionnaires mailed, approximately 64 percent of them were completed and returned. However,

because two of those returned were improperly completed (i.e., demographic data missing), **63 percent** (75/120) were actually used in conducting the analysis. Figure 4 provides a breakdown by functional department of the number of personnel who responded.

The final research phase involved compilation of the survey data into categories corresponding to the investigative questions listed in Chapter I. This compilation consisted of grouping the data by SPO and category (manager, user, or both) and then organizing it into the following reports:

1. Types of software used.
2. Users of PC software.
3. Frequency of Government-owned PC software use.
4. Critical software used.
5. User satisfaction.
6. Software application analysis.
7. Frequency of _personal_ PC software use.
8. Guidance obtained when determining requirements.
9. Who defines requirements in the SPO.
10. Acquisition methods used.
11. Acquisition method effectiveness and efficiency.
12. Alternative acquisition methods.

A qualitative assessment of these reports was then conducted to help answer the investigative questions, draw conclusions about the appropriateness of an alternative PC software requirements model (specifically tailored for SPOs), and make recommendations regarding future research efforts.
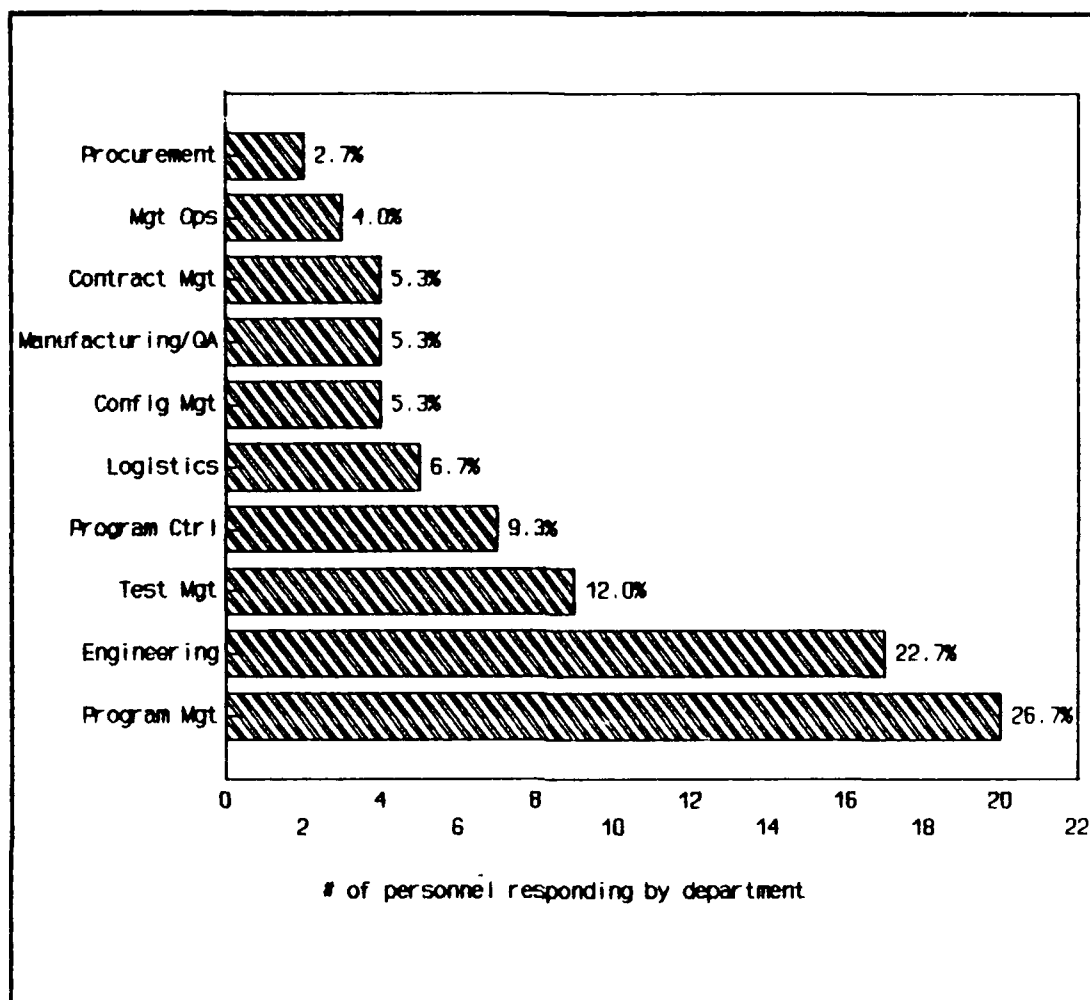
Figure 4. Number of Respondents by Functional Department

<u>Summary</u>

The methodology presented in this chapter was designed to assess the efficiency and effectiveness of the current PC software acquisition process and to provide a baseline for develccing an alternative PC software requirements model for SPOs, if warranted. Chapter IV, Results and Discussion, will address the results obtained from the survey in

answering the investigative questions and their possible implications for developing a PC software requirements model for SPOs.

IV. Results and Discussion

Introduction

This chapter presents the results obtained from the survey and provides an explanation of the way SPOs currently define PC software requirements. It also presents the descriptive and alternative PC software requirements determination models developed from the literature reviewed and survey data collected. The results are organized in the context of the research investigative questions previously delineated in Chapter I.

Findings to the Investigative Questions

1. Who are the users of PC software products in the SPO?

Of the 75 survey respondents, 92 percent (69/75) were identified as users of PC software. As expected, the only individuals not using PC software applications were respondents classified as *managers*. These individuals were all in grades of GM-14/15 or Lt Col and were in authoritative positions to validate PC software requirements for their branch or division.

2.a. What PC software products are SPOs currently using?

All of the SPOs surveyed use a variety of products from the following PC software categories: spreadsheets, word

processors, graphics packages, database managers, integrated

packages, programming languages, and program management

applications. Others used include statistical packages,

utilities, and desktop publishing (DTP) software. The

survey participants identified seven office (knowledge)

tasks which could be augmented using PC software

applications. These tasks included: 1) **authoring,** 2)

presentations, 3) **monitoring/controlling,** 4) **diagnosis/-**

problem solving, 5) **planning,** 6) **organizing/scheduling,** and

7) **decision-making.** Table 7 provides a ranking of the top

three software products by application category which the

surveyed SPOs identified most often as aiding their office

tasks. Rankings were determined in terms of the percentage

of all participants who use a particular product.

(Appendix B provides a basic guide to current PC software

products which may be beneficial to SPOs.) Clearly, the

most often identified software products used by SPO

personnel were word processors and graphics packages

followed by spreadsheets, databases, and integrated

packages. The importance of word processing in SPOs takes

on added significance when one considers that 65 of the 69

surveyed PC software users, or 94 percent, use a word

processor--either as a separate application (like *WordStar*)

or from within an integrated software package (like *Enable*).

Table 7.   Ranking of the Top Three Software Products by Application Category and Percent Use of All Respondents

Word Processors (# used = 58)	% Use	Graphics Packages (# used = 54)	% Use
(1) WordStar	51%	(1) Chart	33%
(2) MultiMate	11%	(2) Harvard Graphics	24%
(3) Microsoft Word	7%	(3) Freelance	7%

Spreadsheets (# used = 30)	% Use	Databases (# used = 27)	% Use
(1) Lotus 1-2-3	29%	(1) Dbase	28%
(2) SuperCalc	4%	(2) Condor	3%
(2) Quattro	4%	(2) DataEase	3%

Integrated Packages (# used = 26)	% Use	Programming Languages (# used = 19)	% Use
(1) Enable	24%	(1) Basic	7%
(2) Symphony	5%	(2) GWBasic	5%
(2) AMS	5%	(2) Fortran	5%

Program Mgt Packages (# used = 18)	% Use	Statistical Packages (# used = 3)	% Use
(1) Time Line	13%	(1) Microstat	4%
(2) Harvard Total Project Manager	4%		
(2) PMSS	4%		

2.b.   How often are these various PC software products used?

Table 8 provides a usage breakdown by software product of the various applications identified by the survey respondents. Easily, the most used application was word processing, with a median usage between five and eight hours per week. This result was anticipated since SPOs typically

	< 2	2-5	5-8	8-10	> 10	Median
Table 8.	**Use**	**of**	**PC**	**Software**	**in Hours**	**Per Week**

	< 2	2-5	5-8	8-10	> 10	Median
Word Processors	3	16	17	8	14	5-8
Graphics Packages	21	19	7	4	3	2-5
Spreadsheets	12	8	3	4	3	2-5
Databases	8	11	5	2	1	2-5
Integrated Packages	15	5	3	1	2	< 2
Project Mgt Packages	13	4	1	---	---	< 2
Programming Languages	14	5	---	---	---	< 2
Statistical Packages	1	2	---	---	---	2-5
Other (utilities, DTP, etc.)	4	1	1	---	---	< 2

process a large number of various memos, letters, reports,
documents, and manuals in the course of directing a system
development effort. Graphics packages, spreadsheets, and
databases (in that order) followed word processors as
receiving the most use on a weekly basis. The second place
finish of graphics packages was initially surprising because
a 1985 study of PC users in 12 organizations revealed the
most popular applications were spreadsheets and word
processors (57:314,316). But considering the substantial
number of presentations made in support or defense of SPO-
directed research and development projects, along with

improvements in graphics package user-friendliness (easy to learn and use), this result is not so startling.

2. c. How satisfied are the users with these products?

Of the 69 respondents who use PC software, 45 percent (31/69) were satisfied with the products currently used to augment office tasks. While only 7 percent (5/69) were completely dissatisfied, over 48 percent acknowledged some degree of dissatisfaction with their office PC software. Those PC software products satisfying user requirements were characterized by such terms as: *user-friendly, versatile, fast, compatible,* and *having excellent help features and quality output.* Dissatisfying products were depicted as being *inflexible, not user-friendly, too slow,* and *incompatible.* Specifically, four products were consistently noted as having favorable or unfavorable characteristics: *WordStar, Chart, Harvard Graphics,* and *Lotus 1-2-3. WordStar* was portrayed as being difficult to learn and use, and having inflexible formatting and file incompatibility with spreadsheets and other word processors. *Chart* was noted for being simple to use, but not having much flexibility or output quality. *Harvard Graphics* was judged a terrific, user-friendly graphics package. But respondents noted, although all functions are available through keystrokes, it needs the use of a mouse to efficiently take

full advantage of its capability. Having no negative
comments was *Lotus 1-2-3* which was characterized as fast,
powerful, and relatively easy to use.

3. *Which PC software products are the most critical for SPOs?*

Overall, the five surveyed SPOs identified the most
critical applications as **word processors**, **graphics**, and
spreadsheets, in that order. *Critical applications* were
defined as the top two PC software products the respondents
depended upon the most. Table 9 gives a breakdown by
functional department of the most critical PC software

Table 9. Most Critical PC Software Applications by SPO Functional Department		
Department	1st Critical	2nd Critical
Project Mgt	Word Processors	Graphics
Test Mgt	Word Processors	Graphics
Logistics	Word Processors	Graphics
Engineering	Word Processors	Spreadsheets
Manufacturing/QA	Word Processors	Spreadsheets
Procurement	Word Processors	Spreadsheets
Contract Mgt	Word Processors	Spreadsheets
Management Ops	Word Processors	Databases
Program Control	Spreadsheets	Word Processors
Configuration Mgt	Databases	Word Processors

applications. As evidenced from the table, the most
critical product for the SPO is word processing since every

functional department has a most critical or second most critical need for this PC software application.

4. Are current PC software products being used for their intended purposes?

Judging from the survey participant's descriptions of the tasks performed with each identified PC software product, it was determined that most of the respondents were using the PC software in ways that are commonly associated with the product applications. Table 10 shows the PC software applications used to support general office tasks. Although there appears to be some potential misuse of word processing for such general office tasks as monitoring/-controlling, organizing/scheduling, planning, and presentations, there is insufficient information to fully support this perception. Moreover, it was not possible to discern whether the application was actually being misused or if some survey participants misinterpreted the purpose of the question since many did not narrate the specific tasks for which they were applying the application. In two cases respondents stated they were using desktop publishing (DTP) software as a substitute for a word processor because they needed to import graphics. Apparently, their available word processor did not have this capability. Although this substitute works, the users probably would have been better advised to use a word processor like *WordPerfect 5.0* or

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Table 10.   Office Tasks and Associated PC Software
            Applications Used by Respondents
-----------------------------------------------------------

                    Total No.     Application Categories
Office Tasks        of Cases      Used & Number of Cases

Authoring              55         Word Processing     = 49
                                  Spreadsheets        =  3
                                  Desktop Publishing  =  2
                                  Graphics            =  1


Decision-Making         5         Spreadsheets        =  3
                                  Databases           =  1
                                  Project Mgt         =  1


Diagnosis/             11         Spreadsheets        =  8
Problem Solving                   Statistical Pkgs    =  3


Monitoring/            34         Databases           = 16
Controlling                       Spreadsheets        = 14
                                  Word Processing     =  3
                                  Graphics            =  1


Organizing/            24         Project Mgt         =  7
Scheduling                        Spreadsheets        =  6
                                  Databases           =  5
                                  Graphics            =  4
                                  Word Processing     =  2


Planning               15         Spreadsheets        =  9
                                  Project Mgt         =  3
                                  Word Processing     =  2
                                  Graphics            =  1


Presentations          44         Graphics            = 31
                                  Word Processors     =  7
                                  Spreadsheets        =  6


Other                  17         Programming         =  8
                                  Communications      =  5
                                  Utilities           =  4


NOTE:   Some individuals used more than one application
        to support a task.
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Microsoft Word 5.0 which are less expensive, user-friendly, and adept at importing graphics. (See Appendix B for more information on these products.)

5. *Are personally-owned PC software products used to accomplish office tasks? Which ones, and why are they used?*

Of the 69 survey respondents who use some form of PC software in their job duties, 23 percent (16/69) acknow-ledged using their own <u>personal</u> PC software to support office tasks. The predominate products used were word processors, followed by spreadsheets and graphics packages. 50 percent (8/16) of the individuals used these products on at least a weekly basis. When asked why personally-owned products were used, 44 percent (7/16) replied they preferred an alternative software product to the currently available government-owned software residing in their respective departments. Another 31 percent (5/16) said the required PC software was either not available or not available in sufficient quantity to be used in support of their duties. These findings help support the rationale for investigating the PC software requirements determination process. A better process of identifying requirements may decrease the use of personally-owned PC software by focusing more attention on user needs to satisfy overall SPO organiza-tional requirements.

6. Is there a departmental policy (formal or informal) establishing a process or method for determining PC software requirements?

Surprisingly, only 37 percent (28/75) of the participants could identify a policy for determining PC software requirements within their respective departments. On the other hand, 19 percent (14/75) stated no policy was in effect, and 44 percent (33/75) did not know whether ヿ PC software requirements determination policy existed. This considerable percentage of SPO survey respondents-- 63 percent--acknowledging either no requirements determination policy or no awareness of a policy is evidence of the lack of attention being focused on the requirements determination process.

7. What guidance do SPOs receive when defining PC software requirements?

Two types of guidance were of interest for this investigative question: 1) consultant or base computer systems (SC) staff assistance and 2) published sources. Figure 5 shows a breakdown of the sources users referenced when identifying PC software requirements.

While Air Force regulations and pamphlets (AFR 700-3, AFR 700-26, and AFP 700-30) suggest personnel consult their base small computer technical center (SCTC) and communications-computer systems (SC) staff, most of the respondents sought *other users* and *magazines*, followed by *SCTCs* for
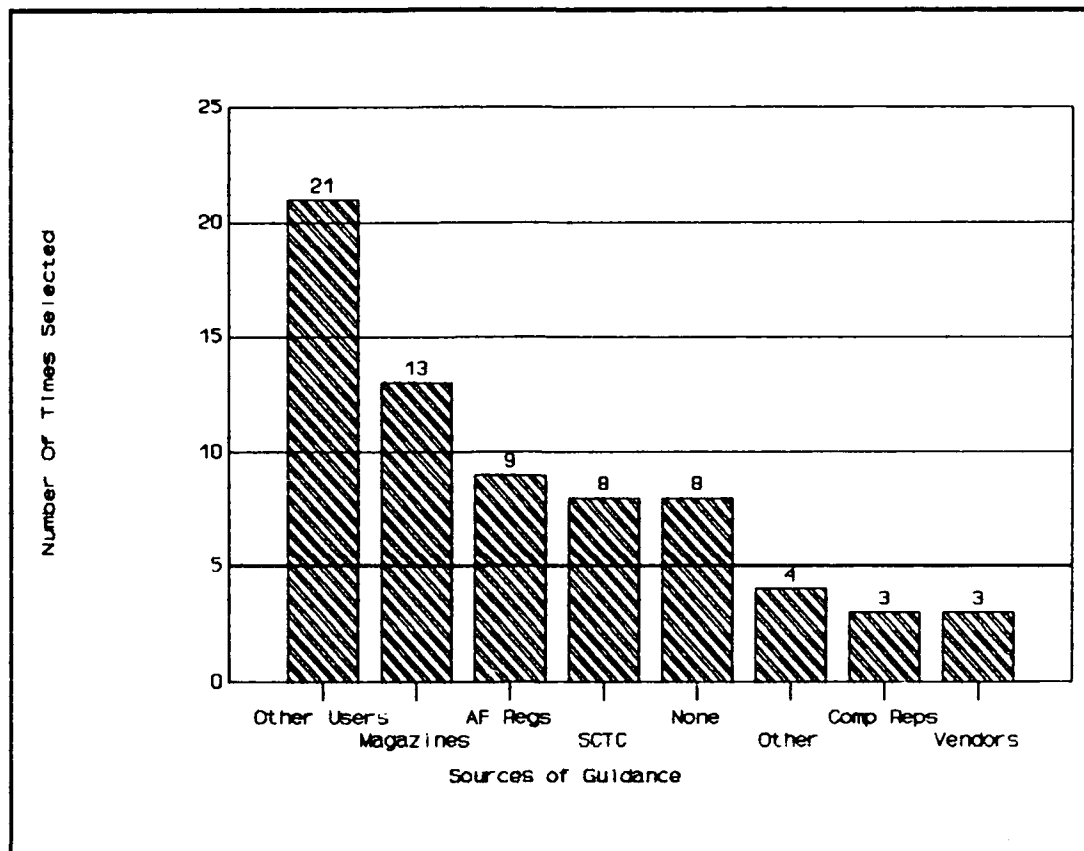
**Figure 5. Sources of SPO Guidance Used When
Identifying PC Software Requirements**

outlining PC software requirements. There were also a
number of survey respondents who said they received *no
guidance* when defining requirements.

These results suggest two implications: 1) personnel
are not aware that regulations, pamphlets, and policy
letters exist offering guidance for software requirements
determination, or 2) the regulations, pamphlets, and policy
letters currently in existence are inadequate to meet user
and organizational PC software requirements. In either

case, these results furnish more support for devoting
additional attention to the PC software requirements
determination process.

8. *Who defines PC software requirements?*

The survey participants who had identified an existing
policy for determining PC software requirements within their
respective departments were asked to identify the person(s)
responsible for the requirements determination process.
79 percent (22/28) of the respondents stated their
department used a designated computer resource represen-
tative. Although this designation is in accordance with the
requirements specified in AFR 700-26, it is not known
whether these persons actually perform all the duties
outlined in the regulation since no data was collected to
corroborate this claim. According to AFR 700-26, this
individual, is responsible for polling office personnel to
determine PC software needs, properly documenting these
needs for elevation to the SPO's software approval
authority, submitting the requirements to the base
communications-computer systems officer (CSO) for validation
and product selection by the communications-computer systems
requirements board (CSRB), and monitoring the request
through the validation and procurement process. Neverthe-
less, six respondents remarked they did not like this

arrangement since it is normally given as an additional duty to less experienced personnel. These individuals typically have limited knowledge about the organization's mission objectives and the importance of PC software in augmenting office tasks in support of those objectives.

For the remaining 21 percent, 7 percent use their office personnel collectively to identify requirements whenever a need arises. The other 14 percent did not know if there was a designated individual who was responsible for conducting the requirements determination process.

9. What acquisition methods do SPOs use when purchasing PC software?

Survey respondents identified five different methods for PC software acquisition:

1. **Standard small computer contract,**
2. **Sole source/special purchase action,**
3. **Small Computer Technical Center (SCTC),**
4. **Self-purchase, and**
5. **Other (software obtained from the Defense Systems Management College [DSMC] and vendors).**

Table 11 provides a percentage breakdown of the acquisition methods used based on the number of PC software acquisitions identified. The most frequently used methods of acquisition were the standard small computer contract and sole source or special (local) purchase actions. The predominate use of the standard small computer contract was expected since AFR 700-26 mandates this purchase method for most software

Table 11.	SPO PC Software Acquisition Methods		
	Acquisition Method	Number of Acquisitions	Percent of Total
1.	Standard Small Computer Contract	83	37%
2.	Sole Source/ Special Purchase	24	11%
3.	SCTC Negotiated Contract	6	3%
4.	Self-Purchase	3	1%
5.	Other (from DSMC and vendors)	3	1%
6.	Do Not Know	108	48%
	TOTAL	227	

acquisitions. The 48 percent of *Do Not Know* responses indicates the PC software was either procured before the respondents' arrival in the SPO, or they were not aware of the acquisition method used once they had identified their requirements. Obviously, requirements determination strategies or methods would have limited impact in the standard small computer contract environment since organizations are limited to the products which have already been prescribed as sufficient to fulfill various office management needs. Although the major advantage of standard small computer contract procurements is product uniformity

over a number of organizations, this is also its major

disadvantage. Different organizations and departments have

varying missions and objectives which may mean dissimilar

office tasks requiring different product applications.

Consequently (as many of the survey participants remarked),

this form of standardized requirements determination (i.e.,

developing requirements without regard for different

missions and objectives) has meant acquiring PC software

applications which are good for some offices, but not so

good for others. For standardization to work, the mission

objectives and goals of organizations must be similar.

10. **How effective and efficient are SPO PC software acquisition methods in providing the correct or requested software?**

Acquisition Method Effectiveness. Over 60 percent

(17/28) of the respondents answering this question stated

their department's current procurement process is

ineffective at providing the correct or requested software.

A multitude of reasons for this general ineffectiveness was

given. However, the overwhelming reason given for the

ineffectiveness was the considerable amount of time the

Government's procurement system takes to process the

necessary paperwork. ⌐   reasons given are listed below:

1. Difficulty obtaining software updates (new software versions).

2. Users have no or insufficient input to the requirements determination process.

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3. Personnel do not know who is responsible for managing the PC software requirements determination and procurement process--i.e., no identified focal point.

4. Insufficient attention to training requirements.

5. Standardization rules are inflexible.

6. Insufficient attention devoted to investigating the "best rated" software products.

7. Persons who validate software requirements have little knowledge or expertise in the software applications needed to streamline office tasks, yet this individual dictates product use for everyone in the department.

Acquisition Method Efficiency. As for efficiency (measured in terms of responsiveness), none of the participants responding to this question said their procurement process was very responsive, while **65 percent** (18/28) of the them felt their procurement process was not very responsive. Primarily, most of the respondents contend the Government's bureaucracy is the reason for the lengthy acquisition time--which ranges anywhere from three months to a year or never. This bureaucracy accounts for the lengthy time to review and validate requests and allocate funds for purchase, orders being misplaced or lost, and competitive buying for large software requirements. This perhaps is the reason why some individuals buy their own software to timely bolster their office tasks.

11. Are there alternative methods or improvements which could be made to the current PC software procurement process?

Survey participants supplied a number of suggestions/comments to improve the current PC software acquisition process. These suggestions/comments were used to assist development of the proposed requirements determination model. Of the 23 responses made to this question, only 17 percent (4/23) suggested methods for increased standardization of the procurement process (like mandating one word processor for all of DoD); whereas, 83 percent (19/23) suggested ways consistent with tailoring requirements to meet SPO mission objectives and goals (like letting departments determine their own requirements and make special or local purchases). A tailored approach would mean each SPO or functional department would have the responsibility and authority to determine requirements and purchase software which best meets the particular needs of the SPO or functional department. A comprehensive listing of participants' comments/suggestions is located in Appendix I.

<u>Unidentified Requirements</u>. Participants were asked to identify primary office tasks which could be supported with PC software, but are currently unsupported. It is quite evident after reviewing the respondents' comments that the current PC software acquisition methods used are inadequate

at identifying requirements and procuring the correct or requested software. Several cases were noted where the current acquisition methods either inadequately identified requirements or where users had difficulty purchasing the properly identified PC software product. Some of these cases are presented below:

1. Eight of the respondents said the reason for their non-support was the inadequacy of the present software acquisition process to supply the necessary product.

2. Another 33 percent (6/18) who had a total of 12 different duties going unsupported replied they did not know whether the duties could be supported when, in fact, some of them could. For instance, two individuals in contract management and procurement did not realize the potential of decision support system (DSS) software (like *Expert Choice* or *Decision Aid*) to assist source selection decisions. Such systems may prove very useful in this regard since they lend structure to unstructured decision problems. These programs have also been used in an academic environment to aid source selection evaluations.

3. In several instances, participants reported no use of software to support a primary duty when perhaps they could have been supported. For example, a configuration manager and management operations manager could use a database management system (like *Dbase* or *Paradox*) to track

system configuration changes and manage personnel issues
(i.e., track performance reports, inbound/outbound assign-
ments, etc.), respectively. Also, 68 percent (15/22) of
branch and division chiefs stated their primary duties as
managing the day-to-day activities of their departments, yet
none of them mentioned using a personal information manager
(PIM) like *Agenda* or *GrandView* which may help managers
automate these tasks. PIMs help managers organize the
tidbits of information which typically cross their desks
every day--like notes, phone messages, etc. This is not to
say PIMs are the answer for all managers, but they do offer
potential benefits to those who would like to automate their
day-to-day activities. (See Appendix B for more information
on PIMs.)

4. A number of respondents complained of the lack of
existing software availability. For instance, a director of
manufacturing/quality assurance remarked that his people
lost time waiting to use a software product available only
in limited quantities.

5. In general, the survey participants were not taking
advantage of spreadsheets and databases to track and monitor
various program activities, like system anomalies,
engineering change proposals (ECPs) and associated comments,
personnel issues, etc. In addition, project management
software, like *Time Line* and *SuperProject Plus*, were not

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being used as prevalently as expected. These relatively inexpensive products can prove beneficial in helping personnel analyze the three main phases of virtually every project: **planning, implementation,** and **evaluation** by breaking the project down into its component parts to facilitate easier scheduling of project activities (39:90). (See Appendix B for more information on project management software.)

Cases such as these lend further support to the premise that current SPO acquisition policies do not devote adequate attention to requirements determination. If they did, then many of the cases presented above possibly would have been precluded as a result of having properly identified software requirements.

The Actual vs The Proposed PC Software Requirements Model

The Descriptive (Actual) Model. This model describes the general method, based on the minority of survey participants who could identify the process, which is currently used by SPOs to determine their PC software requirements. This general methodology is as follows:

1. Personnel identify a need for an application which will assist their office tasks.

2. Individuals primarily rely on other users and magazines to identify specific software products to support specified office tasks.

3. Personnel notify the designated organizational computer representative who checks and consolidates

the requests from other offices. The computer representative then seeks intermediate-level approval/validation of the requests from the SPO director or his designated representative.

4. Requirements then are routed, IAW AFR 700-26, through a computer systems resource document (CSRD) to the base communications-computer systems office (SC) for final approval/validation.

5. Upon approval from SC, the computer systems requirements board (CSRB) attempts to procure the product through the standard small computer contract, if the application (not product brand name) is available. If sufficient justification is given to warrant a specific product (by brand name), then a sole source contract effort is initiated. However, this is all contingent upon funds availability and base-wide requirements priorities.

The major advantage of this methodology is the ease by which users can identify means of simplifying various office tasks. Personnel do not have to seek external advice to help them determine PC software requirements. Nonetheless, there are two serious drawbacks with this approach. First, this descriptive model is hindered by bureaucracy when it comes time to actually procure the requested software. It takes much too long (from three to six months or longer) to get the application to the user. Even if the application does make it to the user, there is no guarantee that this application will be the application requested by product name. Consequently, this is part of the reason why over half of the respondents expressed some dissatisfaction with the products they are currently using. Second, this

methodology, although granting autonomy to the user to identify requirements, does not impose adequate controls on the requirements determination process. Proper controls are necessary to ensure organizational requirements are being met since there is little, if any, mating of user identified requirements with those of the organization (i.e., its mission objectives and goals). For instance, say individuals within a SPO branch decide a DTP package will meet their word processing needs because they need the capability to incorporate graphics with text. However, everyone else in the SPO uses a word processor like *WordStar*. If there is a need for organizations to transfer files between branches, departments, etc. a compatibility problem may arise because the personnel using *WordStar* may not be able to convert the DTP file to a WordStar compatible file. If the organization were making the decision today, a better choice would be the selection of another word processor like *WordPerfect 5.0* or *Microsoft Word 5.0* which could both import graphics and do file conversion. Departments must consider not only their own processing needs but the need for compatibility and interoperability with other departments if they intend to share information. This resulting improper solution to an office task may have been precluded had the organizational requirements been highlighted and given priority in the requirements determination process.

The Suggested or Alternative Model. The following stepwise methodology is proposed to improve the PC software requirements determination process for SPOs. It takes into account the literature reviewed in Chapter II and Appendices C and D and the survey responses gathered in support of this research effort. Specifically, this suggested model is designed to improve the way SPO personnel define, justify, and satisfy their PC software requirements. The _first-year_ model consists of the following steps:

1. *Select a computer resource committee of knowledgeable PC software users to direct the PC software requirements process.* This committee should consist of three or five individuals selected by the SPO director and his staff.

    Rationale: Although organizations have the flexibility to choose either an individual or a committee for this purpose, there is supporting evidence for using committees that approach requirements determination from a management perspective--deciding upon those requirements most important to achieving mission objectives and goals (88:47-49). They will provide a visible focal 'int for PC software concerns comprised of ...dividuals dedicated to finding better uses of PC software to accomplish office tasks.

2. *Set aside a budget for SPO specific software purchases.*

    Rationale: Having a budget already in place will help cut the time typically spent trying to allocate funds for expenditures. Because SPOs typically have more flexibility than other organizations to shift funds from one account to another, this set aside should not be very difficult.

3. *Define the SPO's organizational mission objectives and goals.*

Rationale: This will help SPO members understand the organization's purpose and consider issues like compatibility and interoperability during the requirements determination process. This step should also help members understand how PC software will help them achieve organizational objectives (29:5).

4. *Identify current and potential future critical office functions and outputs necessary to satisfy SPO mission requirements.* This may be done by interviewing the branch (3-ltr) chiefs, division (2-ltr) chiefs, and the SPO director's staff (SPO director, deputy SPO director, and technical advisor).

   Rationale: The goal of this step is to match critical office functions to mission objectives and goals (25:473-496).

5. *Survey all SPO personnel to identify bottlenecks (tasks which limit or prevent user efficiency and effectiveness) in the accomplishment of office tasks.* Start by determining the tasks personnel perform to accomplish their duties, and examine the ways in which PC software, or PC software upgrades, might support those tasks for better efficiency and effectiveness.

   Rationale: This concept of cognitive mapping enables personnel to focus on those tasks deemed most critical to the organization (45:293-295). In addition, user involvement in the planning and defining of requirements is necessary to ensure requirements are defined to meet office automation needs (71:139-140). It also aids the successful implementation of the software since users should be more satisfied with the products selected (94:10).

6. *Separate those office tasks which can be streamlined with PC software from those that have been sufficiently augmented and those that can not be streamlined.*

   Rationale: The committee may want to solicit outside sources of expertise, like the base SC staff, to help them determine which tasks would benefit most from PC software support and make the

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appropriate recommendations to this effect
(67:45-47).

7. *Prioritize those tasks which can be streamlined in order of their probability for lowering mission costs and enhancing mission success.* Conducting interviews with the branch (3-ltr) and division (2-ltr) chiefs and SPO director's staff should supply this information.

   Rationale: This step, taken from the Air Force's Information Systems Requirements Analysis (ISRA) method, helps supply justification for selecting the requirements to automate (29:20).

8. *Group the tasks selected for automation with PC software into their primary application categories (i.e., word processors, spreadsheets, etc.).*

   Rationale: Grouping the tasks in this manner will facilitate easier final selection of the most appropriate PC software product from its parent application category.

9. *Employing such sources as the SCTC, electronic bulletin boards, magazines, vendors, and other users, select a few of the most appropriate software products for evaluation which will accomplish the defined office task(s).* Appendix B may prove useful for selecting products for evaluation.

   Rationale: The survey participants identified these sources as those they turned to for guidance in assisting selection of PC software. There is also evidence supporting the use of these sources to assist personnel in choosing from the vast array of software products available (21:104).

10. *Evaluate the possible software packages in terms of the following factors:*

    a. *Cost*

    b. *Performance* (i.e., How well does the product meet the intended requirement?)

    c. *Compatibility and interoperability of the product with existing and/or pending hardware and software acquisitions* (i.e., Is there

sufficient RAM in the present hardware to run this software?, Does the product easily export/import files?, Is it compatible with the product(s) other departments with whom the users interface use?, etc.)

d. *Legality of use* (i.e., public domain software vs shareware, copy-protection, etc.)

e. *User-friendliness* (i.e., How easy is it to learn and use?)

f. *Training requirements* (i.e., How much is needed?, How much does it cost?, When is it available?, etc.)

Rationale: These evaluation criteria were taken from AFP 700-30 and the feedback obtained from the survey participants on Questions 12-14, and 17. It should allow SPOs to effectively evaluate PC software products for selection.

11. *After soliciting feedback from the prospective primary users, select the product which best meets the need and criteria.*

Rationale: PC software products should be evaluated with the objective of matching the best possible product with the intended office task.

12. *Submit the request to the SPO director or his designated representative for approval.*

Rationale: This is an important aspect since, ordinarily, requests are approved by SC. However, the SPOs should have the final approval authority for purchases outside of the standard small computer contract since they are in the best position to ascertain what products will best fit their needs. This is the same line of reasoning many authorities have used to justify decentralized control and decision-making (58:5-11).

13. *Purchase the desired software.* These purchases should be made through the Standard Small Computer Contract if the requested product is available by this means. If not, use a SCTC negotiated contract or sole source or local purchase action.

> **Rationale:** Although the purchase process would perhaps be faster if organizations were allowed to make direct purchases, the Government procurement process for software is mandated in AFR 700-26. This study did not specifically address improvements to the purchase process.

14. *Use the product for a specified period of time (perhaps two to three months), and then conduct a follow-up evaluation.*

> **Rationale:** The purpose of the follow-up evaluation is to ensure the product is meeting its intended purpose. Obtaining feedback is an essential element of good management control (25:485-486).

15. *Conduct re-evaluations at least once per year.*

> **Rationale:** This will ascertain whether the product is continuing to satisfy the intended requirement and whether a new product or upgrade (new version) is needed--part of the feedback mechanism.

Important to note is that this proposed methodology bypasses the communications-computer systems requirements board (CSRB). The primary rationale is that the CSRB cannot guarantee a requirement will be funded since they have a limited amount of funds to manage. Funds are allocated to the CSRB to help meet organizational needs base-wide which usually means organizations will not have all of their needs met within their requested time frame. Some organizations will inevitably have unfunded requirements. These requirements may or may not get funded depending upon when monies become available again and the priority given to those particular requirements. This method is more

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efficient because it gives SPOs the authority to procure the software application they desire when they want it (i.e., in a more timely fashion). It also ensures the specific product requested is the one which will be procured. The present CSRB system does not guarantee the product requested will be the product procured to fulfill a valid requirement.

As stated before, the proposed model, as previously defined, is applicable to a first-year PC software requirements analysis. For subsequent years and out of cycle PC software requirements, the individual or department need only identify the requirement to the requirements committee. The committee will then compare this requirement to the previously prioritized tasks in Step 7 to determine whether the requirement has already been prioritized or needs to be prioritized. If the requirement already exists, the requirements committee will just continue from Step 8; otherwise, they will prioritize the requirement IAW Step 7 and continue the process. Using this suggested or alternative model may result in better mission need and office task analysis and thus, better PC software product procurements to fulfill those needs.

Summary

Presented in this chapter are the findings of the research investigative questions and analysis of the survey

responses from 75 individuals representing five SPOs--one each from the five product divisions in AFSC. These findings and analyses were used to construct the present PC software requirements determination model--called the descriptive model--used by SPOs. Along with the literature reviewed from Chapter II, these findings and analyses were also used to develop the proposed Suggested or Alternative SPO PC Software Requirements Determination Model. This model potentially outlines a more efficient and effective means of specifying PC software requirements in SPOs, but it remains to be tested to this effect. The basic approach is to match SPO mission objectives and functions to critical office tasks and then determine the best software products available to assist personnel in accomplishing those tasks. Chapter V, Conclusions and Recommendations is based on the findings and analyses and the descriptive and suggested PC software requirements determination models discussed in this chapter.

V.   Conclusions and Recommendations

Introduction

This chapter provides answers to the research objectives identified in Chapter I, and conclusions regarding the descriptive and alternative requirements determination models presented in the previous chapter for SPO PC software.   It also discusses recommendations for future research associated with PC software requirements determination.

Answers to Research Objectives

Objective 1:   *Determination of the effectiveness of currently available PC software applications used to support SPO tasks.*

Current PC software applications are meeting most SPO identified office needs with word processors touted as the most critical software applications.   However, SPO personnel are not fully satisfied with their PC software products, citing such reasons as product incompatibility, lack of user-friendliness, slowness, and inflexibility as the causes of their dissatisfaction.   Also, personnel were somewhat disgruntled regarding the lack of updates (new versions) to their presently available PC software products.   In many instances, if updates were readily available, jobs presently unsupported could be supported with the same product line. For example, many users of earlier *WordStar* versions are

frustrated with its inability to import graphics and conduct file conversion (i.e., *WordStar* to ASCII, etc.). *WordStar 5.0* has this capability, but users have had little success acquiring it although earlier versions were on the Standard Small Computer Contract. The inability to acquire software updates causes the available PC software to be less effective than it could be. Moreover, a number of software requirements which could be met with existing PC software either go unidentified or unsupported. Both of these problems could be lessened with better requirements determination procedures.

Objective 2: *Determination of the current processes SPOs use to identify PC software requirements.*

The majority of surveyed personnel sought other users and magazines when guidance was requested in determining requirements, instead of the SC staff as outlined in Government regulations. In addition, several respondents sought no forms of guidance during requirements determination. This implies one or both of the following: 1) personnel are not aware various regulations and policy letters exist offering guidance for software requirements determination, or 2) the regulations and policy letters in existence are inadequate at assisting personnel to define their PC software requirements.

Moreover, over 60 percent of those surveyed were unable to identify any existing policy within their respective departments for determining PC software requirements. This may or may not be disturbing depending upon whether these unknowing individuals have a need to identify PC software requirements. If they do have a requirement but do not know the means to identify it, then this requirement may go unidentified. Those persons who did recognize an existing policy overwhelmingly named a **designated computer resource representative** as the person responsible for directing their organization's requirements determination process as stipulated by AFR 700-26. But this method can potentially place too much responsibility on one individual who many times is too inexperienced to make the best decisions.

Both of these findings suggest the current PC software requirements identification methods are inadequate. A good requirements determination methodology should be visible to all personnel and employ persons to head the process who are knowledgeable of the organization's objectives and functions and the importance of PC software in supplementing office tasks in support of those objectives and functions.

Objective 3: *Determination of the methods SPOs currently use to acquire PC software products.*

Not surprisingly, the most frequently used procurement method is the Standard Small Computer Contract which is

specified by AFR 700-26. In addition, numerous purchases are accomplished using a sole source or special (local) purchase action.

Although procurements IAW the Standard Small Computer Contract assure product uniformity between organizations, care must be taken to develop requirements with regard for different mission objectives and functions. The rationale is that organizations with different mission objectives and functions may have different PC software needs. Since such product standardization may only work well when organizations share similar mission objectives and functions, avenues should remain available for sole source or special purchase actions. These actions should be left to the discretion of the individual SPO organizations as they are in the best position to determine what their special requirements are.

Objective 4: *Determination of the effectiveness of present PC software requirements identification and procurement practices.*

Current SPO requirements identification methods are inadequate to fulfill organizational needs. The reason for this inadequacy is that not enough emphasis is placed on this section of the procurement process. Personnel are not aware of the regulations and policies governing PC software requirements identification, and they generally do not know

who is responsible for conducting/managing the requirements determination process.

Present SPO procurement practices are also lacking. They are deficient in both supplying the correct or requested software and doing it in a timely manner. The reason for this ineffectiveness and inefficiency primarily rests with the Government's procurement system. This system takes a long time to process a request, and there is no guarantee the organization will receive the particular software requested. However, this is not all the fault of the CSRB. They are hampered by limited budgets which results in a number of unfunded organizational requirements. Nonetheless, decentralizing the procurement process so individual organizations could be responsible for small, non-standard (SPO-unique), off-the-shelf, PC software expenditures would greatly enhance the process. In this way, SPOs would most likely receive the correct/requested PC software in a timely fashion.

Objective 5:   *Determination of whether the development of a tailored PC software requirements model for SPOs might improve the PC software acquisition process.*

From the literature reviewed and the survey data collected, it is apparent that improvements made to the requirements determination process is a key step in improving the PC software acquisition process. Although the

CSRB serves a legitimate purpose trying to prioritize and meet base-wide organizational requirements with limited funds, Government bureaucracy is acknowledged by the researcher as a major obstacle to improving the PC software procurement process. A sound requirements determination process is an essential first step to ensure the right software is identified to fulfill the mission need. Without this requirements determination step, actual procurement effectiveness and efficiency is meaningless if, as three respondents remarked, the acquired software is inadequate to meet the mission need. Thus, the suggested model offers substantial improvement over the descriptive model (the methodology presently used by SPOs) described in Chapter IV. It focuses on matching SPO mission objectives and functions to critical office tasks and then investigating/selecting those PC software products best suited to fulfill office task(s) in support of mission needs. This methodology relies on the ability of the SPO director and his staff to select a committee of both mission and PC software knowledgeable personnel. These persons must be able to consolidate mission objectives and functions with a prioritized list of critical SPO tasks which could be augmented using PC software to support the mission objectives and functions. The committee must also be

responsible for investigating and recommending the best

possible PC software product to meet the desired task(s).

Recommended Research Solution

The research developed Suggested or Alternative Model is

recommended to assist SPOs in the requirements determination

process for PC software. Employment of this methodology

should help SPOs better define, justify, and satisfy their

PC software requirements. The steps to the suggested or

alternative PC software requirements model are recapped

below:

1. Select a computer resource committee of
    knowledgeable PC software users to direct the PC
    software requirements pr cess.

2. Set aside a budget for SPO specific software
    purchases.

3. Define the SPO's organizational mission objectives
    and goals.

4. Identify current and potential future critical
    office functions and outputs necessary to satisfy
    SPO mission requirements.

5. Survey all SPO personnel to identify bottlenecks
    (tasks which limit or prevent user efficiency and
    effectiveness) in the accomplishment of office
    tasks.

6. Separate those office tasks which can be
    streamlined with PC software from those that have
    been sufficiently augmented and those that can not
    be streamlined.

7. Prioritize those tasks which can be streamlined in
    order of their probability for lowering mission
    costs and enhancing mission success.

8. Group the tasks selected for automation with PC software into their primary application categories (i.e., word processors, spreadsheets, etc.).

9. Employing such sources as the SCTC, electronic bulletin boards, magazines, vendors, and other users, select a few of the most appropriate software products for evaluation which will accomplish the defined office task(s).

10. Evaluate the possible software packages in terms of the following factors:

    a. Cost

    b. Performance

    c. Compatibility of the product with existing and/or pending hardware and software acquisitions

    d. Legality of use

    e. User-friendliness

    f. Training requirements

11. After soliciting feedback from the prospective primary users, select the product which best meets the need and criteria.

12. Submit the request to the SPO director or his designated representative for approval.

13. Purchase the desired software.

14. Use the product for a specified period of time (perhaps two to three months), and then conduct a follow-up evaluation.

15. Conduct re-evaluations at least once per year.

In addition, some SPOs may find portions of the questionnaire in Appendix H useful (as did one SPO during this research effort) in helping them identify office tasks which may potentially benefit from PC software applications.

Specifically, Survey Questions 3 through 8 may prove useful

for this task. It may also help SPOs identify those office

tasks where modifications to existing PC software are

necessary (i.e., updated software versions or different

software products) to improve current office task support.

Questions 11 through 14 may be beneficial for this purpose.

Recommendations for Future Research

The conclusions drawn from this study are assumed to be

an accurate depiction of the SPO organizations surveyed and

were meant to be generalized to all SPOs within AFSC.

However, due to the limited sample size (75 total

respondents) and SPOs surveyed (one from each of the five

product divisions), these generalizations may not hold for a

larger sample size of SPO organizations and personnel.

Therefore, future researchers may want to employ the

questionnaire in Appendix H on a larger scale for both SPO

organizations and personnel.

Although the Suggested or Alternative Model for

determining PC software requirements was specifically

developed for SPOs, it remains to be tested. Moreover, it

may have applications for a number of other organizations if

tests prove positive. Thus, other researchers may wish to

test/investigate how well this model could meet SPO and

other organization's PC software requirements needs.

Other researchers may also want to explore the area of PC software training within organizations. This area is critical because if prospective users receive inadequate training in how to use the acquired PC software tools, they will not know how to best integrate them to support their office tasks.

Another area for future study is the role of the information center in supporting the use of PC software within organizations. These centers could potentially be responsible for conducting PC software requirements analysis, procurement administration, providing training, and application development. Consolidating these functions into one department may revolutionize the way the DoD manages PC software.

Finally, future researchers may want to re-examine the concept of standardization of PC software among SPO organizations. This standardization could be either AFSC-wide or product division-wide where each organization would have uniform PC software products. Administration of procurement, training, and requirements analysis might be the responsibility of a SPO information center located at each product division. This structure may reduce training requirements for reassigned personnel, make software purchases cheaper due to large quantity procurements, and

still offer SPOs increased productivity over the idea of standardizing PC software Air Force or DoD-wide.

Research Summary

This study was conceived to explore better ways of conducting PC software requirements analysis. It is based on a survey of 75 participants representing one SPO from each of the five product divisions within AFSC. Although limited in scope, this research accomplished five major objectives. First, it determined the effectiveness of currently available PC software applications used by SPOs. Second, the study examined the current processes SPOs use to identify PC software requirements. Third, it explored the methods SPOs currently use to procure PC software. Fourth, it examined the effectiveness of present PC software requirements determination and procurement practices. And, lastly, this research aided the development of an alternative PC software requirements determination model tailored to SPOs. This Suggested or Alternative Model is based on mating SPO mission objectives and functions with critical office tasks necessary to accomplish these objectives and functions. It then investigates/selects those PC scftware products which will best support the office task(s). Use of this model should better able SPOs to define, justify, and satisfy PC software requirements.

Functioning in an era of continued manpower reductions, coupled with a philosophy of "doing more with less," has prompted the Air Force to acquire more PCs in hopes of automating various office tasks for increased productivity. This quest for more productivity is exemplified in SPOs where timely, organized, and accurate information is essential to a successful acquisition program. PCs, although relatively inexpensive, are sophisticated management tools requiring various application software packages to efficiently and effectively automate office tasks. However, the proliferation of PC software on the market has made choosing the right software for the right job a difficult proposition. The Suggested or Alternative Requirements Determination Model provides a comprehensive methodology for assisting SPOs in determining their PC software requirements. Better determination of PC software requirements should make choosing the right software for the right job an easier task, thereby resulting in enhanced mission effectiveness.

Appendix A: <u>Glossary</u>

Application Programs (or Software) - Computer programs used to perform specific user tasks, such as word processing, database management, etc. They may be general-purpose or specifically designed to address unique tasks (30:6).

Communications-Computer System - A combination of facilities, procedures, hardware and software, transmission media, and other resources used in processing, transmitting, emitting, or receiving information by electromagnetic or electronic means (27:6).

Communications-Computer Systems Requirements Board (CSRB) - The corporate body established at base-level, MAJCOM, and HQ USAF to validate communications-computer systems requirements and approve or disapprove technical solutions (27:6).

Communications-Computer Systems Officer (CSO) - At base-level, the commander of the communications unit responsible for carrying out base communications-computer systems responsibilities (30:10).

Electronic Bulletin Board - A system which connects users and a common host which is used to exchange software programs, technical information, and other information (30).

Information Systems Requirements Analysis (ISRA) - This stepwise methodology helps organizations identify ways to improve their mission effectiveness by enhancing information management systems which in turn help decrease mission support costs and increase the probability for mission success (29:1).

Knowledge Tasks - These are the tasks involving thinking, information processing, and the formulation of analyses, procedures, and recommendations. Such tasks include: communication, planning and decision-making, diagnosis and problem solving, system development, monitoring and control, organizing and scheduling, and authoring and presentation (25:409).

Operating System Software - *Package of system programs* resident in the computer (like PC-DOS, MS-DOS, etc.) which manages all computer hardware system functions, like file and disk management and coordinating application programs; it provides the link between the user and the computer (96:4-7).

Personal Computer (PC) - A specific class of electronic hardware, including associated software and peripherals, capable of executing a variety of software programs. It characteristically consists of (at a minimum) a central processing unit (CPU) with random access memory (RAM) and

read-only memory (ROM), disk drive, keyboard, and a visual display terminal (VDT) [25:66].

Public Domain Software - Software which has been released by the author to the general public at no cost. It is non-copyrighted, non-copyprotected software which usually offers no support or guarantee of accuracy (30:10).

Requirement - A need for a new or improved way of capturing or processing data, producing information, controlling a business activity, or supporting management. If this need is satisfied, it could potentially increase mission success and/or decrease mission support costs (88:66; 29:1).

Requirements Determination - The process of using strategies and procedures to evaluate management goals/-objectives and behavior characteristics to fulfill a user application need. It involves studying the current information systems to discover how it works and where improvements can be made (25:473-496; 88:66).

Shareware - Privately or commercially developed software which is usually distributed free of charge for trial period use. However, after the trial period, a fee is generally expected for continued use. Support is often implied or promised by the author, but it is usually minimal (30:10).

Software Product - Specifically named application programs like Condor, WordPerfect 5.0, MathCAD, etc.

Software Type - Categories in which software products may be placed, like spreadsheets, word processors, decision support systems, etc. (44:7).

Standard Personal/Small Computer Contract - An Air Force-wide contract used to procure PC resources (both hardware and software) [30:3].

User - Personnel who actually use computer systems and/or associated products.

User Involvement - Getting input during the system requirements development process from the personnel who use or will use the computer system and/or associated products.

Appendix B: <u>Guide to Current PC Software</u>
<u>Applications for SPOs</u>

In this section, brief ratings of the various PC software

products which a typical SPO might use are presented for

reference. These ratings have been compiled from the

leading computer magazines. These magazines include <u>PC</u>

<u>Magazine</u>, <u>Byte</u>, <u>PC World</u>, <u>Compute!</u>, and <u>Personal Computing</u>.

The software products rated are not meant to be everything

to everyone. Rather, they are meant to give the prospective

user a basic starting point to conduct further investigation

into these and other products available in the desired

category which may be best-suited to their particular

application need. Products rated include word processors,

spreadsheets, databases, program managers, integrated

packages, program information managers, mathematical

packages, decision support packages, statistical packages,

and graphics packages.

Word Processors. Perhaps more than any other PC software

program, a good word processor is a requisite for almost

every office and manager. This is no great revelation when

one considers the diversity of forms, letters, memos,

manuscripts, and documents which are common-place in today's

office environment. Just a few years ago, choosing word

processors was merely a question of style or preference.

But today, there are some clearly top products which can

make your writing much easier. Granted, because of familiarity and custom, it is difficult to convince people to change word processors (74:45). However, given the tremendous capabilities of the three products briefly described below, the switch may be easier than you think.

Microsoft's *Word 4.0* ($450) is rated as one of the best because of its breadth and depth of features. For starters, it is one of the fastest word processors around and has exceptional formatting features which include "style sheets" for creating reusable page designs or document formats. It also offers excellent mouse support to make formatting and editing much faster and such features as macro and basic math operations and an outline processor. (Outliners compose documents in outline form, and it also serves as brainstorming tools to organize an argument into major and minor points.) Moreover, the latest version (Version 5.0) has enhanced graphics import and page-composition features, along with an integrated page preview function (7:99-101; 74; 82).

Lotus' *Manuscript 1.0* ($495), geared toward engineering and scientific word processing, might be precisely what the engineering, test, and perhaps logistics management SPO departments need. Although slower and less easy to get used to, *Manuscript 1.0* provides the features necessary to produce a host of scientific and technical articles and

reports. Among them are its ability to depict complex scientific equations and the ability to import and merge various graphics files with text. The basic approach used to assemble a document with *Manuscript* is different from the ordinary word processor. It builds documents with "blocks" (which may be paragraphs of text or complex tables of equations). To do this, *Manuscript* uses a top-of-the-screen menu line, pop-down menu boxes, dialogue boxes, and typed backslash commands much like Lotus' *1-2-3*. A great outline processor, two-sided printing, excellent help features, a 100,000 word dictionary, and macro and merge capabilities are just a few of its other features (74; 78; 82).

However, *WordPerfect 5.0* ($495) by WordPerfect Corporation is the consensus choice as the best all-around word processor. In fact, it was rated by PC Magazine as the best word processor of 1988 (11:110,130) and as a "Best Buy" for 1989 by PC World (7:97). This products "artful compromise between word processing and desktop publishing, supplies a complete set of features for creating highly visual documents" (74:45). It offers all of the features outlined for Microsoft's *Word 4.0* (except mouse support), including the ability to combine text and graphics (with the ability to rotate and resize), an undelete feature, superb help features, document summary page, automatic document backup control, a preview function, and the ability to read

and write different file types like ASCII, Wordstar, Multi-Mate, etc. (7:97-98). As for portability, no word processor is better as it runs on a number of machines, including MS-DOS, Apple II series, minicomputers, Macintosh, and IBM mainframes. And for user convenience, it even has a toll-free service line (41; 78; 74; 82).

Spreadsheets. These allow the user to process and analyze information by utilizing the computer's ability to calculate and display data in the form of numbers. They have been adapted for forecasting, modeling, and providing business reports (63:69; 78:63). Although every spreadsheet can crunch a column of numbers, they each are unique in terms of performance and features. Lotus' *1-2-3* has been at the top of the spreadsheet market for so long that choosing a spreadsheet has been a very easy decision. However, as Lisa Kleinman (a software analyst for Personal Computing magazine) writes, "Suddenly it's more like buying a word processor: There's a strong leader, but lots of other attractive choices [as well]" (53:49). The four products discussed below should help users decide whether they should make a change.

Microsoft's *Excel 1.0* ($495) is highly rated due to its myriad of features and great versatility. This easy to use spreadsheet has 131 built-in functions, automatically recalculates sensitivity analysis tables, and comfortably

handles multivariate and logarithmic regression. *Excel* also possesses true presentation-quality graphics, file linking, an undo command, and the ability to store macros with their individual spreadsheets. Nonetheless, for such outstanding performance, there is a tradeoff--speed. *Excel* is rated one of the slowest spreadsheets on the market, but improvements are in the works (4:141-143,156; 53:49; 63:72).

Borland International's *Quattro* ($248) gets a "Top Rated" evaluation from <u>Personal Computing</u> magazine (Sep '88) because of its all-around performance and value (19:143). This spreadsheet offers both speed and an abundance of features to please almost everyone. With a price tag half that of Lotus' *1-2-3*, *Quattro* is attracting a lot of corporate management attention (19:143; 86:72). It has the ability to import and export *1-2-3* files and has a command structure much like *1-2-3*'s. However, its pull-down menus are more simple to read and interpret than *1-2-3*'s. Some of its redeeming features are: 1) its 10 graph types, 2) its 100 mathematical functions, including regression analysis, frequency distribution, and sensitivity analysis capability, 3) easy macro debugging, 4) Turner Hall's popular SQZ! utility to automatically compress and expand files for more efficient disk space utilization, and 5) file linking and multiple windows to come in its next version (19:145-147; 53:49).

If speed and low cost are premium, then Paperback Software International's *VP-Planner Plus* (Version 2) is the obvious choice. It retails for a low $180, but earned a "Top Rated" billing from <u>Personal Computing</u> magazine (Sep '88) for its speed and versatility (4:147-149; 53:49). *VP-Planner Plus* is *1-2-3* compatible with menus following the *1-2-3* convention. Some of its best features include word processing, box and line drawing, file linking, a powerful multi-dimensional database, and an undo command with a 60K buffer. And, unlike other spreadsheets, it does not have to wait for a recalculation to finish before entering other entries or commands.

Nevertheless, Lotus' *1-2-3* is the market leader to which all other spreadsheets are compared, garnering almost 70 percent of all spreadsheet sales in 1988 (4:130,139; 86:73). This year (1989), Lotus introduced two new versions of *1-2-3*: Releases 2.2 and 3.0. Release 2.2 is a smaller version of 3.0. Release 2.2 runs only with DOS and has enhanced graphics, file linking, search and replace, a built-in macro learn mode and superb macro capability, and network support. Release 3.0 will only work with PCs that have at least one megabyte of random access memory (RAM). Besides the size of 3.0, its best features are three-dimensional worksheets (i.e., rows, columns, and pages), and excellent graphics with a choice of eight fonts. In fact,

Release 3.0 gives the capability to view a graph alongside its accompanying worksheet and reflects changes to data automatically in the graph (53:74).

Database Managers. In recent years, database management users have become much more demanding of their database management systems (DBMS). Users today want "programming clout to create sophisticated applications, as well as advanced querying and reporting tools they can master without memorizing a manual" (60:118). As a result, the age of the *relational database* has dawned, while the popularity of the *flat-file database* is beginning to fade. A flat-file database or file managers (as they are now called) organizes data into "simple two-dimensional tables that resemble spreadsheets [or paper forms]." The major disadvantage of file managers is they only permit the user to work with one file at a time, thus users must close the first file before viewing another. Likewise, data from multiple files can not be pulled into one report (92:77). File managers are generally associated with typical office administrative tasks like recording and filing information. Although not specifically reviewed, the best file managers include *PFS: Professional File*, *Reflex 1.14*, and *Q&A 3.0* (rated the best in 1988 by PC Magazine) [41:110; 92:77-82].

On the other hand, relational databases are based on a set of tables which represent unique entities or records

which are linked by a common field. In this manner, data can be pulled from other files to generate new files for viewing, editing, calculating, or reporting (25:123-125; 92:84). It also makes updating records easier since updates made to parent records also update the child records (60:122). Reviewed below are four of the best relational database managers.

DataEase 4.0 ($700) from DataEase International has become very popular in many corporations because users can design their own applications by following easy to use menus instead of writing program code. However, for the serious developer, *DataEase* falls far short. It also lacks the industry standard structured query language (SQL) and the new query-by-example (QBE) system which makes command line querying a thing of the past. Nonetheless, *DataEase* offers excellent capability for the beginning user (19:52; 18:182-183; 60:126-128).

A few years ago, *R:base* ($725) from Microrim took the PC relational database market by storm when it introduced a dynamic command language and a very highly touted application generator (18:188; 60:118,125-126; 92:86). A "Top Rated" product by Personal Computing magazine in November 1988 (18:182-183), it is still one of the best database managers for the avid programmer. It has a variety of modules and features. Among the modules are: 1) a

Definition Express module to construct a network of complex

linked tables, including a Rules submodule (which allows

automatic validation of data entries and a Views submodule

(which combines as many as five tables of related data),

2) a Forms Express module to design sophisticated windows

for adding, updating, and deleting data from up to five

tables at once, 3) a Reports Express module which organizes

data into report form, and 4) an Application Express module

to construct personal applications, like help screens,

menus, data-entry forms, reports, etc. by simply following

the prompts (92:86). Some of its more impressive features

include superb spreadsheet-like financial analysis

capability, cross-tabulation, and impressive speed, network

(only one package is required to serve multiple users), and

SQL support (60:125-126; 92:86). Nevertheless, *R:base* is

not a very user-friendly database for the casual user, it is

targeted for the serious programmer with a good knowledge of

command syntax (60:125-126).

Borland International's *Paradox 3.0* ($725), another "Top

Rated" product by <u>Personal Computing</u> magazine for 1988,

possesses super-fast speed and overall superior performance

for users who do not like or need much programming

flexibility (18:182; 60:120). However, the programming it

does offer is fast and very easy to learn although it can

not rival that of *R:base* or *Dbase IV* (60:120). Some of its

most redeeming features are built-in graphics which lets the user create pie, bar, line, and stacked bar charts effortlessly; excellent screen and report generators; cross-tabulation statistics; superb querying with QBE; and a new operator called SET which permits fine relational algebra capability. But a major drawback is *Paradox*'s lack of SQL which may drive away potential users in spite of its otherwise smooth operations (60:120-125; 92:87-88).

Ashton Tate's *Dbase* has been to database management what Lotus' *1-2-3* has been to spreadsheets--the market leader. **Dbase IV** is no exception; it has recaptured the lead for PC database managers with this improvement over *Dbase III+*. Perhaps the biggest improvements have been its increased user-friendliness and application development (60:119; 85:98). Its Control Center is one of the best as it "automatically catalogs all queries, labels, forms, and reports and opens them with their related database" (60:119). *Dbase IV* touts a menu-driven application generator which surpasses its rivals and should please both the avid programmer and the casual user. Programmers can write complex programs by simply linking forms, labels, and reports. They may then be edited with its first-rate editor, and it also has a compiler which automatically catches syntax errors before the program is run. *Dbase IV* also offers excellent data entry screen generators and top-

notch report generation capability. Although it provides

for QBE and SQL, *Dbase IV* is slow in conducting these

queries (in relation to *R:base* and *Paradox*). As well, the

SQL system is awkward which *Dbase IV* (Version 1.1)

supposedly has fixed. Still, it is the database manager to

beat because of its superior development tools and user-

friendliness (60:119-120).

Integrated Packages. As one analyst notes, "Integrated

software is the computer world's answer to the Renaissance

man--do everything with competence, if nothing with

excellence." An integrated package gives the user an all-

in-one collection of software applications. These

application tools typically include a word processor,

spreadsheet, database, communications, and graphics.

Integrated software offers the user simplicity (ease of use)

and compatibility between different application files

(1:30). Products reviewed fall into two categories: those

low-end packages costing less than $300 and those on the

high-end costing over $300.

In the low-end category, two packages stand out:

AlphaWorks 1.0 and *Microsoft Works 1.05*. Both earned "Best

Buy" ratings from <u>PC World</u> magazine (Apr '89) [34:96,99].

AlphaWorks ($195) from Alpha Software Corporation uses

many standard file formats which makes it easy to swap files

between users with other applications. This program allows

the user to keep up to 29 files open (9 each in word

processing, database, and spreadsheet and 2 in communi-

cations) and toggle between them. Word processing is simple

and has automatic reformatting, rapid search, and a 120,000

word thesaurus. However, it only permits ASCII files to be

imported and exported. The database is very adaptable using

the standard Dbase.dbf format and supplies an unlimited

number of records. The spreadsheet has 75 functions (more

than *1-2-3*) and uses the 1-2-3.WKS format. It also has more

user-friendly pop-down menus. *AlphaWorks* has integrated

graphics with five chart types which are easy to use and a

solid communications package (34:95-98).

"An impressive piece of software artistry, *Microsoft*

Works," according to Dennis Dykstra (analyst for <u>PC World</u>

magazine), "sports an elegant interface, a first-class

spreadsheet, great graphics, and mouse support." Retailing

for $149, it comes with an excellent manual and magnificent

tutorials. *Microsoft Works 1.05* has an array of word

processing features and a very good database. unfor-

tunately, neither the spreadsheet or database use industry-

standard file formats. It does have an outstanding

spreadsheet module which reads and writes both *1-2-3*'s .WKS

and .WK1 files. The spreadsheet also automatically

translates *1-2-3* formulas when *1-2-3* files are loaded. In

addition, the integrated graphics module links charts to

worksheets which when updated also update the charts. The graphics module also supplies a variety of text fonts and sizes. While the communications module is limited, *Microsoft Works 1.05* ranks as the best all-around choice (34:99-100).

On the upper-end of the price spectrum, there are essentially two industry leaders: *Symphony* and *Enable*. Both of these packages retail for $695 and offer the same basic features, plus some enhanced capabilities.

However, there is an important message to be heard in reference to integrated packages. That message is that although integrated packages offer all-in-one convenience, they can not be everything to everyone. By their nature, they typically can not perform tasks to the level of expertise required by most users who use specific PC software application packages.

Project Management Software. Until very recently, PC project management software have suffered from being either too difficult to use or lacking functionality. However, today there are some very capable programs costing less than $600 which can assist the program manager in imposing structure on the complex interaction of time, resources, and activities (40:177,187). Since virtually every project contains the three main phases of planning, implementation, and evaluation, project management software aims to address

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these phases by helping break down a project into its component parts (which is usually necessary for good management control) [39:90]. These programs offer excellent ways to track and analyze information for a project (40:177). Project management software is particularly suited to manipulating date and time information in devising a project schedule. They integrate such management science techniques like program evaluation and review technique (PERT) and critical path method (CPM) to determine a project's estimated completion time, along with the various task duration estimates and the most schedule constraining or critical tasks. Using charts and graphs (like PERT and Gantt), project managers allow the user to visually monitor the progress and costs of a project. Although these programs obviously can not take the place of sound program management practices, they can be a big help by arranging tasks by priority and within a specified time period. As Harvey Levine, chairman of the board of the Project Management Institute in Drexel Hill, Pa. (a professional society for program managers) states, "This kind of program is so inexpensive today that I don't know why anyone who needs to control a schedule or costs would use something else" (39:90). The two programs presented below-- *SuperProject Plus* and *Time Line*--should provide excellent support to the average program manager.

SuperProject Plus (Version 3.0) listed at $395 by Computer Associates International possesses a host of features. Among them are an outliner, a work breakdown structure (WBS) chart, a resource histogram for resource management, multiple report types, and Gantt and CPM chart capability. This program, rated an "Editor's Choice" by PC Magazine in 1988, also has two skill levels allowing beginners to take advantage of this tremendous capability as well as skilled program managers. In addition, if the manager desires macro capability and the ability to import files from other programs, an enhanced version is available called *SuperProject Expert* ($695). It also has network capability, plotter support, additional report types, and PERT (which addresses the uncertainty in a project by using probability to assign each task an optimistic, pessimistic, and most-likely time duration (40:224,187-188).

Another "Editor's Choice" award from PC Magazine in 1987 and 1988 is Symantec's *Time Line* (Version 3.0) at $595. This user-friendly package boasts an outliner, superb report types, excellent note-taking capability, 27 macro-like shortcut command keys, macro programmability, a resource histogram, a WBS chart, and Gantt and CPM charts, and an undo/redo command which is very useful for sensitivity analysis (40:222-225).

There are also a number of other project management programs available (like *Harvard Total Project Manager*, *Microsoft Project*, etc.) which may be well-suited to fulfill the needs of a manager. Before selecting any of these project management packages, potential users may well be advised to consider the tips outlined in Table 12. Still, these programs may provide invaluable assistance to the average inundated program manager.

Personal Information Managers. Because this area of PC software applications is so new (early 1988), many managers may not be aware of this application. Personal information managers (PIMs) are designed to allow users to easily retrieve, analyze, and cross-reference data--both words and numbers. Personal information consists of those random pieces of information which cross the typical manager's desk every day, like notes scribbled on a scratch pad, phone messages, annotations made on various documents, lists of things to do that day, important phone numbers to remember, etc. (17:92; 93:282). PIMs are designed to organize these random bits of daily information which do not easily fit into a rigid format like databases or word processors (17:92; 77:105). Lotus Corporation, the first to take advantage of this management need, lists three essential criteria for PIMs:

    1. They should be specifically designed to
       handle random, free-form entries consisting

```
Table 12.   Tips for Selecting a Project Manager  (39:93)
------------------------------------------------------------

1.  If your project is simple and involves little
    scheduling, or if only a few people will be
    involved, then perhaps a traditional program like
    a word processor, outliner, spreadsheet, or
    database might be sufficient.

2.  Use programs that handle planning only if you are
    just going to develop a blueprint for a project.

3.  To monitor a project, program management software
    should compare your target plan to the actual time
    and costs expended.  Likewise, the program should
    not overwrite target dates or costs when you make
    adjustments to the cost and/or duration of
    individual tasks in a project.  The program should
    do this at any point in a project, not just at the
    end.

4.  Look for good hard-copy tabular and graphics
    reporting features.  Reports can be important tools
    when dealing with top management or clients.  The
    ability to link the management program to a plotter
    for Gantt and PERT charts is a nice plus--it makes
    reports look that much better.

5.  If you need to do special analytical tasks on
    project costs, or prepare reports which only a
    database can produce, get a project manager that
    can share data with other programs--preferably in
    their original formats.

6.  Make sure the program you choose is straightforward
    and easy to understand.  A complicated program may
    just sit on the shelf.
```

of short pieces of text (words, phrases, sentences,
or lists).

2. They should be all-purpose tools with the
   flexibility to manage anything from lists of
   things to do to brainstorming sessions.

3. They should be able to link various
unstructured bits of information, thereby
enabling the manager to establish working
relationships between otherwise separate
items (77:106).

Surprisingly, of the approximately 25 PIMs on the market

today, only 4 were judged by Personal Computing magazine

(Jul '89) as meeting this criteria. they are: *Info-XL* by

Valor Software, Polaris Software's *PackRat*, *GrandView* by

Symantec Corporation, and Lotus' *Agenda* (77:106).

Info-XL uses a very pragmatic approach to information

management. It uses an outline as its primary organizing

structure, but it uses several other structures as well. In

fact, *Info-XL* uses "six distinct, on-screen windows to

manage and relate information." The Manager window allows

the user to enter text as headlines and subheadlines; the

Records window is used to enter database information, like

names and addresses; the Comments window can handle pieces

of completely unstructured text, like notes; the Daily

Schedule and Monthly Calendar permit outlined data items to

be listed in chronological order with a time and date; and

the Search window gives the manager the ability to extract

all entries containing a specified word or phrase (77:109).

PackRat functions superbly in the environment of

Microsoft Windows, although it does work outside these

confines. This is an important point for the manager who

already uses *Windows* because if he does, then the obvious choice for a PIM is *PackRat*. This program houses seven excellent utilities. Among them are a Phone Book equipped with auto dialing and label printing; a Phone Log with ample note space; a Task (to do) List which allows priority and status setting; an Agenda (appointment schedule) complete with visual and aural reminders; an Expense Log that has unlimited categories and summary totals; a Disk File Log equipped with notes on data files and the ability to load applications; and Index Cards for taking notes on miscellaneous text and graphics. *PackRat* also keeps an on-screen calendar to display information from any of its utilities by specifying a date or range of dates (e.g., show all to-do items for the week from the Task List utility). As well, it allows the manager to link and retrieve information by selecting key words and by attaching an item from one utility to another utility (17:170; 77:111).

GrandView is another PIM which is structured around an outline. But beware; it is so outline structured that it may not be a wise choice for managers with a different cognitive style since it forces the manager to think where the next item should fit before it is actually entered (17:170). Nonetheless, *GrandView* is an excellent product. Text is entered as headlines and subheadlines in familiar outline form. The word processing capability is arguably

the best of all the PIMs; it has a text editor, spell checker, and even provides multiple printer font support. *GrandView* uses categories to link separate entries, like categorizing by date and priority. This PIM seems particularly suited to managers who use tidbits of information as seeds for greater things like memos, letters, briefings, reports, etc. (77:108-109).

Agenda has been billed as the "quintessential PIM" by Personal Computing magazine and was selected as one of the "Best Products of 1988" by PC Magazine (77:106; 11:130). This is an "open-ended, highly adaptable program with the power to connect entries as other PIMs cannot." It is so flexible because it has very little apparent structure. Data items are entered under section headings in any format the manager desires; syntax rules are non-existent. *Agenda* provides real power in its ability to link these items in categories which the user defines. Using the Condition function, managers can customize *Agenda* to automatically assign items to categories, given they meet the pre-defined criteria (like containing a certain word or belonging to another category). The Action function gives the manager the opportunity to make modifications when assigning new items to existing categories. This function also enables the user to conduct operations like deleting and exporting files. *Agenda* also offers extensive macro capability and

several artificial intelligence (AI) features to make matching items to categories much simpler. For instance, it can be programmed to recognize synonyms like "Chuck" for "Charles" or "PM" for "program manager," and it can also translate such words as "tomorrow" and "end of the week" into their proper dates for assigning items to time-related categories (77:106-107). Although *Agenda* is a PIM with exceptional capabilities, learning to use this tool can be quite challenging, making it a tough choice for managers with little time for learning a new product. However, once it has been learned, *Agenda* is a super PIM which can be modified to suit individual manager's needs (17:170; 77:107).

Mathematical Packages. "Ten years ago," according to Barry Simon, "machine-driven scientific calculation was neatly split into two phases: serious number crunching on a mainframe and simple calculations on a hand-held calculator." However, today the PC has filled this middle ground void by making it possible for mathematical packages to perform either or both of these roles. These packages can be easily divided into two groups: 1) non-programmable packages intended for calculating and modeling and 2) programmable packages (which possess full-fledged mathematical languages) intended for tasks requiring custom programs which might be written in *Fortran, Turbo Pascal, C,*

etc. Natural scientists and engineers, along with some social scientists, programmers, and financial model builders find tools such as these invaluable (91:289-290).

Although there are quite a number of programs a SPO engineering department may find beneficial, only two of the best (one programmable and one non-programmable) are reviewed here.

<u>PC Magazine</u> rates Microsoft's *MathCAD* ($295) as the best of the mathematical software programs without extensive programming language. This program is very easy to learn and is well-suited to the everyday needs of engineers, scientists, and mathematicians. It lets the user write equations using familiar mathematical notation (which are immediately calculated) and integrate text (to explain or summarize) anywhere with ease in a "what-you-see-is-what-you-get" format. *MathCAD* even plots the mathematical functions instantly on the computer screen. The program is very comprehensive, handling an assortment of operations like matrices, simultaneous equations, automatic unit conversion, real and complex numbers, and a host of trigo-nometric and statistical functions. It also automatically flags errors and supports a variety of printers (91:290-295,308).

For programs with extensive programming language, the choice is less clear among such programs as *Asyst*, *MathGraf*,

Matlab, *TK!Solver Plus*, *Curve*, and *Gauss*. Nonetheless, *Gauss* by Aptech Systems earned "Editor's Choice" honors from <u>PC Magazine</u> in March 1989. It offers impressive speed, which is key for performing calculations, in an easy user interface and an excellent programming language. *Gauss* also has quick graphics along with superior presentation-quality graphics (91:308).

<u>Decision Support Packages</u>. This category of PC software may prove beneficial for every SPO where a number of decisions are made almost daily. Decision support software is designed to help managers provide structure to complex problems by breaking them into manageable portions. These systems <u>do not</u> actually make decisions, but they provide a tool for evaluating alternatives. Selection of the most appropriate alternative is left to the manager (2:1). Two of these products are reviewed for this study as an intro- duction to decision support software for the PC. They are *Expert Choice* and *Decision Aide* which both retail for $495. These products were reviewed by the researcher on a personal basis and in an academic setting.

Expert Choice allows the user to develop a hierarchy of criteria to give the appropriate consideration to each aspect of the decision process, along with assessing the risk level. It is based on the Analytic Hierarchy Process developed at the Wharton School of Business and allows users

to prioritize factors and criteria based on qualitative (verbal judgments) and quantitative assessments (38). *Expert Choice* also uses information screens for note taking and assessing data from a spreadsheet or word processor. In addition, it gives the user the capability to fully document the decision model with one command (37). This mcdel has also been used very successfully in an academic environment to evaluate proposals for source selection.

Decision Aide offers the same capability as *Expert Choice* to develop a hierarchy of qualitative and quantitative assessment criteria. The program is segmented into eight separate modules: 1) Plan Your Decision, 2) State Decision, 3) Establish Criteria, 4) Generate Alternatives, 5) Evaluate Alternatives, 6) Assess Adverse Consequences, 7) Make Choice, and 8) Print Report. There is flexibility to use as many or as few of these modules as required to support a decision analysis (26).

Statistical Packages. Unlike most general PC applications, such as word processors, databases, spreadsheets, etc. which use similar conceptual frameworks, statistical packages use an array of frameworks. As Robin Raskin (a statistical analyst for PC Magazine) states, "... you'll be hard pressed to find any two that are alike in their 'look and feel' or methodology." Consequently, users must evaluate the myriad of statistical packages on their

own. With over 200 commercial statistical products and several hundred shareware programs, choosing the right package can be a harrowing experience. For purposes of this review, statistical packages were broken into two categories: basic and advanced. Basic packages are those handling a variety of basic statistical procedures, like descriptive statistics, linear regression, analysis of variance, discriminant analysis, cross-tabs, and non-parametric tests. Those labeled as advanced packages are characterized by big, comprehensive programs which have a number of additional statistical procedures, along with data handling and programming capability (80:103-104).

In the category of basic packages, PC Magazine chose two products for their coveted "Editor's Choice" award. *Minitab Statistical Software* ($695) and *Statistix* ($169). Both of these tools import and export ASCII files, diagram histograms and scatter plots, and perform descriptive statistics (mean, variance, etc.), linear regression, and analysis of variance. Individually, *Minitab Statistical Software* offers simplicity in a more-than-adequate command language and good macro capability. *Statistix* provides 75 of the most commonly used statistical functions in a fairly flexible menu-driven system. It also has good data handling capability (80:169-199).

For advanced statistical programs, three packages were chosen by PC Magazine as "Editor's Choice" recipients. They were *SPSS/PC+*, *Systat*, and *Statgraphics*. All of these packages have a programming language making it possible to design a complex statistical procedure. These programs are faster and can handle larger data sets than the basic packages. They also have higher-level operations like multivariate analysis, time-series analysis, factor analysis, and non-linear regression, along with sophisticated data editing, handling capabilities, and diagnostic routines for testing underlying assumptions (80:121).

SPSS/PC+ ($795) is the offspring of the popular mainframe version of SPSS. Although it does not fully emulate the mainframe version, *SPSS/PC+* does provide a powerful substitute. Interactive menus and interactive execution make this a very manageable and productive program. *SPSS/PC+* produces excellent charts and tables, but is lacking when it comes to data management and regression with analysis of variance (ANOVA) [80:161].

On the other hand, *Systat* ($795) performs well with linear models like ANOVA regression and has a very user-friendly, powerful command language (partly because it was developed on a PC) and terrific graphics. However, *Systat's* performance lacks in the cross-tabs area (80:161).

Statgraphics ($895) was developed on a PC specifically for PC users. As a result, it has a terrific user interface and command structure with powerful menus. It also has superior graphics capability (80:161).

When it comes to statistical PC software, it is important to realize that no one package will meet the user's every need. One package may have a superior forté in one required area and be very poor in another. The key is to seek those packages which will provide the best coverage of procedures the user deems most critical (80:161).

Graphics Software Packages. This area of PC software is common to virtually every SPO department. Graphics software contain tools for drawing, charting, designing, making presentations, and producing various combinations of these tasks. Today, graphics programs are directed at specific tasks like charting complex data for trend analysis or creating color slides to enhance a visual presentation (73:126). However, this is not the way it used to be. In the not so distant past, the art or reprographics departments controlled this area which meant managers were at the mercy of these departments for assistance and therefore had to adhere to their time and personnel constraints. However, the emergence of the PC and graphics software have given the manager more flexibility to manage this required capability. This does not mean art departments are obsolete; on the

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contrary, these departments will always have more and better equipment and more experienced personnel. However, now managers need not wait on art departments to fulfill routine requirements. And they should not since "about 70 percent of all graphics created by art departments are nothing more than word charts," according to Jim Meade of Personal Computing magazine. By creating word and other simple charts themselves, users have the advantage of being able to give more thought to their ideas and can make last minute changes with a minimum of inconvenience (65:55). This is especially important considering the long lead-time typically required by graphics departments. Moreover, users can make sure the charts are accurate if they do them themselves. Meade provides the following general rule to follow: "When content matters most, users should generate their own charts. When appearance takes precedence, turn to the art department." He further points out that, generally, presentations made in-house do not require the level of quality as that needed for presentations outside the organization (65:55).

Deciding upon a PC graphics software is not as difficult as some analysts believe, if the user is trying to choose the top-rated program. Clearly, the top-rated graphics program is Software Publishing's *Harvard Graphics* (52:128;

89:134). However, there are a number of other choices including Micrografx's *Graph Plus* and Lotus' *Freelance Plus* (52:128-129).

Freelance Plus (Version 3.0) at $495, provides "fill-in-the-blank" worksheets in which the user enters data and then selects a chart option. The method produces very handsome presentation-quality graphics. The program boasts a straightforward user interface and an ample context-sensitive help menu. *Freelance Plus 3.0* consists of three modules: 1) Charts and Drawings to produce and improve charts; 2) Portfolio, an organization utility which lists up to 100 files by topic, file path, and name, with the ability to print them in batch mode; and 3) Screen Show for developing on-screen slide shows with a number of transition effects like slow fades and overlay techniques (54:139-141).

Graph Plus ($495) is a <u>PC Magazine</u> "Best Product of 1988" award winner (11:130). This sophisticated program operates under *Microsoft Windows* and is better suited for the experienced graphics user since it is not the easiest of programs to master. However, it does provide excellent integration capability with other applications (especially spreadsheets) and is compatible with a wide range of printers and plotters (52:128; 75:143-145).

The industry leader, *Harvard Graphics* (Version 2.1) at $495, has earned the "Top Rated" award from <u>Personal</u>

Computing and the "Editor's Choice" award from PC Magazine

(76:145; 89:134). This presentation graphics program

incorporates "an uncommon combination of simplicity and

depth." It offers an abundance of features like macros;

batch printing; customization using drawing functions,

symbols, and color and patterns; importing and exporting

data files of other applications; support for a host of

printers and plotters; a Screenshow utility for incor-

porating special effects in desktop presentations; and

commendable documentation. But, perhaps *Harvard Graphics'*

biggest plus is its ease of use. This program is ideal for

the manager who does not have the time or inclination to

experiment with different packages in search of the one that

works best for him/her (76:145-149).

**Appendix C: Strategies for Assisting Information
Requirements Determination**

Renowned MIS author, Gordon Davis outlined <u>four</u>

strategies for aiding the determination of information

requirements.   A brief discussion of these strategies is

presented below.

The *asking directly* strategy tasks the analyst to

obtain information requirements directly from the persons

who will be using the application by simply asking them what

their requirements are.   This concept assumes the users are

able to appropriately define and limit their problem areas

and overcome any biases due to small sample size, recency of

the requirement, unused data, and concreteness of the

perceived requirement (24:13-14).   This strategy is most

useful when the requirement is well-defined or established

by law, legislation, or other authority.   The use of closed

questions, open questions, brainstorming, guided

brainstorming, and group consensus are the diverse methods

for employing an asking strategy (25:481).

The concept of *deriving from an existing information
system* may be used when the existing system has an

operational history from which requirements can be derived

for a similar kind of organization or application.   Davis

lists four types of existing information systems which are

useful for deriving future system/application requirements.
They are:

1. An existing system being replaced by a new
   system,
2. An existing system in another, similar
   organization,
3. A proprietary system or package, and
4. Descriptions in textbooks, handbooks,
   industry studies, etc. (25:482)

Since information systems generally provide information services to facilitate operation by those that utilize the information (object systems), the requirements, therefore, originate from the activities of those object systems. Consequently, Davis suggests the most logical and complete way to determine those requirements is to study the characteristics of the object or utilizing system. This *synthesis from characteristics of the utilizing system* approach is believed valid when the utilizing system is changed or the proposed system is different from the existing system (in content, form, complexity, etc.) so that basing requirements on the existing system will not provide a complete and accurate set of requirements (24:14). Davis lists eight general methods for implementing a requirements determination strategy. They are briefly described below.

1. **Normative Analysis** – This method is based on the fundamental similarities between classes of utilizing system. It says, given a generic set of requirements associated with a general application (i.e., accounting,

inventory control, etc.), the analysis centers on tailoring

the basic set of requirements to a specific organization or

application (24:15-16). However, it is primarily applicable

at the organizational level (i.e., for determining

organization-wide requirements) [25:483].

2. **Strategy Set Transformation (SST)** - This approach,

developed by W. R. King, describes organizational infor-

mation requirements from the basic mission, objectives,

strategies, and other strategic variables of the organi-

zation. This method is designed predominately for the

organization level (51:27-30).

3. **Critical Factors Analysis** - Information

requirements are derived from a set of factors managers view

as critical to the successful operation and management of

the organization (24:16-17). A good example of this method

is the *Critical Success Factors (CSF)* method developed by

J. F. Rockart. Using CSF, analysts solicit users to define

those factors which are essential for success in performance

of their duties or decision making. A small group of

critical factors usually emerge from which requirements can

be derived (83:81-93). This technique may be used at either

the organization or application (i.e., for specific depart-

ment task requirements) level (25:485).

4. **Process Analysis** - This approach concentrates on

the notion that business processes (collection of activities

and decisions necessary to manage organizational resources)
are the basis for information system support. Since
processes, assumedly, remain constant over time, the
requirements derived from these processes reflect the
constant needs of the organization (24:17). It is most
applicable for organizational requirements determination
(25:485). A good example of this method is *Business Systems
Planning (BSP)*. This IBM developed technique allows
information requirements to be derived from the utilizing
system in a top-down fashion by first identifying the
business objectives and then defining the business processes
to develop a proposed information architecture (20).

5. **Ends-Means Analysis** - This technique separates the
definition of ends or outputs (goods, services, and infor-
mation) from the means (inputs and processes) generated by
an organizational process. The ends or outputs from one
process is used as the input for another process. For
instance, the inventory process may provide raw materials to
the production process. Managers are first asked to define
the ends and means for their respective offices, followed by
the measurements for effectiveness and efficiency. This
method has been used in many industrial settings and is more
tailored to defining organizational requirements
(25:485-486).

6. **Decision Analysis** - This approach has proven very useful in determining information requirements where the decision process is fairly well defined. The basic process has three steps: 1) identify the decision to be made, 2) define the decision algorithm or process, and 3) describe the information required for the decision process (24:17). For unstructured decisions, this method does not seem any more effective than the others. It is primarily designed for specific application-level requirements (25:486-487).

7. **Socio-Technical Analysis** - This technique is based on the philosophy that organizational behavior problems are the principle cause of information system failures (14:17). It consists of two parts: social analysis and technical analysis. The social analysis considers the social, human interaction aspects of the organization in determining requirements; whereas, the technical analysis takes into account design analysis and feedback systems which require information (24:18). The general approach has three phases: 1) a strategic design process (formulation of project goals and objectives), 2) a socio-technical system design process (emphasizes design procedures and the social change process), and 3) an ongoing management process (continual fine-tuning of the system implementation) [14:17]. This approach is appropriate for applications involving many

users, or where the application will greatly impact the work environment, social interaction, or job design (25:487).

8. **Input-Process-Output Analysis** - This systems approach to requirements determination begins with a top-down design of a utilizing system concentrating on the inputs, outputs, and transformation process. Subsystems of the utilizing system are analyzed to subdivide them into smaller subsystems until information processing activities can be defined as separate activities within a subsystem. The advantage of this form of analysis is that it is both systematic and comprehensive. "By starting at a high level and factoring into subsystems, there is reasonable assurance of completeness." The analysis can be taken to as low a level of detail as necessary. The data flow diagram is an excellent example of this method. The Structured Analysis and Design Technique (SADT) is a requirements determination methodology based on this systems approach (25:487-488). It will be discussed later in this chapter.

Most traditional methods for determining information requirements are intended to provide a complete and accurate set of requirements prior to designing and building the actual information system. However, many times these traditional methods will not be possible due to the lack of an existing model on which to base requirements. As a result, another approach to requirements determination is to

start with a general set of "best guess" requirements and implement an information system to reflect those requirements. This approach is called *discovering from experimentation with an evolving information system*. This initial system should be designed for easy change because as users make use of the system, they will inevitably have additional requirement requests. After establishing a workable system, the user and analyst can work together iterating the system design until it fits the users' needs. This strategy has been often referred to as *prototyping* or *heuristic* development (25:488,568).

Appendix D: Description of Common Requirements
Determination Methodologies

This appendix supplies a brief description of some

common methodologies used to assist information requirements

determination within organizations.

Data Flow Analysis.   This methodology employs a

pictorial representation of the flow of data in carrying out

specific office functions.   The data flow diagrams use just

four symbols to show how all essential parts of the

investigated information system fit together (88:112).   The

idea is to furnish a top-down structure of the logical

system design by "moving from lesser to greater levels of

detail that contribute to the design process" (62:143).   In

this way, analysts and users may better define the steps in

the flow of information and the decision-making process

(62:141-143).   The steps in data flow analysis are as listed

below:

1.   Study the office operations and ongoing
     processes.

2.   Identify how data is processed in handling
     transactions and completing tasks.

3.   Follow the flow of data from input to
     processing to storage to retrieval to
     output.

4.   Gradually add details at lower levels.
     (88:112)

The advantages of this methodology are two-fold. First, it is simple to apply which means it is easy to get users involved in the requirements determination process. Second, it allows the analyst to concentrate on areas of interest to find better ways of performing a particular task (88:114-115).

Structured Analysis and Design Technique (SADT). This proprietary system for requirements determination is devised to "force structure on the unstructured systems analysis and design task" (62:140). It is unique in that it incorporates techniques for performing both systems analysis and design, as well as management practices to apply these techniques which can substantially increase the productivity of an analyst team (47:1-1). SADT is composed of a graphic language for model building, a method for model development, and management practices for controlling the system/application development (62:140).

With the aid of the graphic modeling language, SADT attempts to guide the analysts into a top-down decomposition of the problem (62:140). It uses a diagramming technique which subdivides information processes into activities (actigrams) and data flow (datagrams). SADT uses the following functional phases of analysis:

1. Diagramming activities and data aspects pertaining to the system.

2. Cross-referencing of activity and data diagrams.

3. Additional activity and data diagramming and cross-referencing, as needed, to complete the functional analysis.

4. Analyzing the sequence of activities.

5. Identifying mechanisms which will implement the functions and act as a bridge to the design phase. (47:3-2)

Although SADT is an enhancement of data flow analysis (allowing teams to work and interact as one to solve complex information problems [84:161]), it is not an easily applied methodology. It requires a number of resources in terms of people (normally four to six analysts and support personnel) and time (usually ranging from six to nine months). In addition, SADT does not integrate users into the process very well (62:140-141).

The two requirements determination methodologies previously discussed, represent relatively opposite ends of the spectrum with regards to complexity and the amount of resources demanded. The three methodologies which follow are considered more moderate approaches to requirements determination.

Cognitive Mapping. This methodology is designed to isolate bottlenecks in the flow of information to assist analysts and users in focusing on those tasks which are deemed most critical to the organization. It is described

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as a mental method of representing the relationships between functions or tasks which are perceived to exist and the examination of these relationships empirically to determine whether they truly do exist (67:45-47). Cognitive mapping is comprised by the following eight steps:

1. Identification of the user set and interfacing organization.

2. Identification of decision areas.

3. Definition of decision areas.

4. Development of a descriptive model of the system.

5. Development of a normative model of the system.

6. Development of a consensus model of the system.

7. Decision model identification and specification.

8. Specification of the information requirements. (67:45-46)

This methodology is believed to yield excellent results in very unstructured office environments. It enables users to determine those tasks which are most important for completion of their daily projects (67:45-53).

Critical Task Method (CTM). This methodology was developed to determine users' office computer needs. It assumes the users (knowledge workers) are best equipped, rather than the systems analysts, to understand and identify the critical *bottlenecks* (tasks that limit or prevent user

efficiency and effectiveness) in an unstructured office

environment. CTM begins by determining what tasks managers

perform to accomplish their duties, and it uses the idea of

task descriptors to define these various management

responsibilities (45:293-295). Below is a brief description

of the five steps in the Critical Task Method.

1. **Interview a subset of the knowledge workers.** This is done to determine what jobs managers perform and how they do them.

2. **Develop a profile of task descriptors.** This gives a breakdown of *maintenance* and *cognitive* tasks. Maintenance tasks are routine duties which do not directly produce a product (e.g., doing calculations, typing, filing, etc.); whereas, cognitive tasks are higher level mental operations which produce an end product like reports or forms.

3. **Develop a profile of the support modes.** This is just a listing of the various modes of support the managers use to *assist* their duties.

4. **Validate the profile of task descriptors and support modes.** This listing is reviewed for accuracy, clarity, and completeness, and to make any necessary additions or modifications.

5. **Survey the hold-out sample.** The remaining knowledge workers are given the completed listing of CTM task descriptors and support modes to determine the critical bottleneck tasks. Participants are then asked to choose the critical cognitive tasks necessary to fully define their work bottlenecks. They are also asked to provide up to six modes of support they presently use to overcome the bottlenecks (45:294-295).

Information Systems Requirements Analysis (ISRA). This

stepwise methodology (developed by the Air Force) helps

organizations identify ways to improve their mission

effectiveness by enhancing information management systems which, in turn, help decrease mission support costs and increase the probability for mission success. It is designed for use by either individual offices or entire organizations (29:1) and consists of the following 11 steps:

1. Selection of managers to participate in the analysis based on personnel who are under their immediate supervision.

2. Identification of the unit's operational mission.

3. Preparation of a list (by each participating manager) of the responsibilities assigned to the manager's section or branch, including wartime and additional duties.

4. Preparation of an Analysis Worksheet (AF Form 3231) for each responsibility identified in Step 3.

5. Analysis of the information recorded on the Analysis Worksheets to identify requirements which will achieve the objectives: 1) increase the probability of operational mission success or 2) decrease the cost of mission support.

   a. First, identify requirements which can be satisfied by implementing procedural changes.

   b. Second, identify requirements that cannot be satisfied by making procedural changes.

6. Recording requirements on the Requirements and Justification Worksheet (AF Form 3230).

7. Completion of the Information Systems Requirement Document (ISRD) IAW AFR 700-3. The ISRD specifies the required capability, justifies the need, identifies available resources, and serves as the validation and approval document for that need.

8. Submission of the ISRD to the Information Systems Review Board (ISRB) for review and validation of properly justified requirements IAW AFR 700-5.

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9. Implementation of information technology or procedural changes based on the ISRB validated requirements.

10. Evaluation of the implemented information technology or procedural changes to ensure objectives have been met.

11. Reporting of evaluation findings back to the ISRB (29:4-34).

The ISRA method provides the basis for a very thorough requirements determination analysis; however, it entails an arduous and time-consuming process. In interviews with various AFSC SPO managers, this method has been doomed to failure due to the tremendous time and effort required to implement this process. Various AFSC base communications-computer systems officers (CSOs) echo these sentiments when they convey that organizations are discouraged from pursuing this approach to requirements determination when they learn the amount of time and energy involved to satisfy a requirement.

Appendix E: Sample Survey Cover Letter Addressed to Deputy SPO Directors

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-6583

REPLY TO
ATTN OF: LS (Capt Richardson/LSA/AV 785-5?3?)

SUBJECT: SPO Personal Computer (PC) Software Requirements Model
Development Survey (USAF Survey Control No. 89-37)

TO: Selected SPO Directors/Program Managers Within AFSC

1. Please take the time to distribute three of these question-
naires to each of your functional departments for completion.
They should be returned in the envelopes provided by 9 Jun 89.

2. The survey examines how your SPO identifies PC software
requirements, how the software is procured, and how the develop-
ment of a tailored software acquisition model for SPOs might
simplify the software procurement process. The data gathered
will be used as part of an AFIT research project, and may
potentially improve the software acquisition process.

3. For each set of three questionnaires distributed to your
functional managers, please have one completed by at least a
branch chief (or equivalent) and the remaining two by personnel
in ranks below the branch chief level. This is important to
obtain a cross-section of personnel who use PC software and who
identify software requirements.

4. Personnel surveyed may be military and/or civilian. Their
responses will be combined with others and will not be personally
attributed to them or to your SPO.

5. Your participation in this research effort is completely
voluntary, but your assistance is certainly appreciated.
Any questions concerning this survey should be directed to
Lt Col D. J. McBride, AFIT/LSY, AUTOVON 785-4845.

JOHN DUMOND, Lt Col, USAF
Head, Department of System
    Acquisition Management
School of Systems and Logistics

2 Atch
1. 30 Questionnaires
2. 30 Return Envelopes
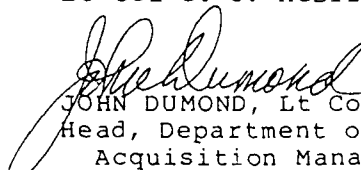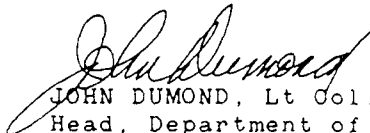
STRENGTH THROUGH KNOWLEDGE

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-6583

REPLY TO
ATTN OF: LS (Capt Richardson/LSA/AV 785-5435)

SUBJECT: SPO Personal Computer (PC) Software Requirements Model
Development Survey Package

TO: All Participants

1. Please take the time to complete the attached survey and
return it in the envelope provided by 9 Jun 89.

2. The Department of Defense, functioning in an era of continued
manpower cuts, coupled with a management philosophy of 'doing
more with less,' has prompted the Air Force to acquire PCs as an
office automation technique to increase office productivity.
Perhaps nowhere is the value of the highest possible office
productivity greater than in SPOs, where timely, organized, and
accurate information is essential to the success of an acquisi-
tion program. PCs, as relatively inexpensive, yet sophisticated
office management tools, require various application software
packages to efficiently and effectively automate office tasks.
But with the abundance of PC software tools on the market,
choosing the right software for the right job can be a difficult
proposition. The problem is there are no comprehensive criteria
for assisting SPOs in determining their PC software requirements.

3. Your assistance in this study will help to identify what PC
software applications SPOs currently use, how PC software require-
ments are identified, what PC software acquisition processes are
used, how effective the current acquisition processes are, and
whether an alternative PC software requirements model for SPOs
might be beneficial. The data gathered will be used in support of
an AFIT research project, and may potentially improve the current
PC software acquisition process.

4. Participation is completely voluntary. Your responses will be
combined with others and will not be attributed to you personally
or to your SPO.

5. Thank you for your assistance in this research effort. If you
have questions regarding this survey, please contact Lt Col D. J.
McBride (AFIT/LSY) at AUTOVON 785-4845.

JOHN DUMOND, Lt Col, USAF   2 Atch
Head, Department of System   1. Questionnaire
   Acquisition Management   2. Return envelope
School of Systems and Logistics

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Appendix G: Sample Survey Instructions

INSTRUCTIONS FOR COMPLETING SPO PC SOFTWARE

REQUIREMENTS MODEL SURVEY

The attached survey is designed to gather information in the following areas of SPO PC software requirements determination:

1. How effective and efficient is your department's use of PC software?
2. How are PC software requirements determined for your department?
3. How effective is your department's current process in determining PC software requirements?
4. Is there an alternative process better suited to identify these software requirements?

The survey will take about 25 minutes to complete and consists of a variety of multiple choice, dichotomous, rating scale, and open-ended questions. For each multiple choice, dichotomous, and rating scale question, please circle the letter or range corresponding to your selected answer. Some of the multiple choice, dichotomous, and rating scale questions also ask for a brief explanation, depending upon your response. In addition, a few open-ended questions have been incorporated to give greater freedom of response. Your opinions and constructive criticism of the current process for determining PC software requirements are important. Please write legibly to be sure we include your opinions in the analysis.

Finally, when you have completed the questionnaire, please return it in the preaddresed envelope. Your cooperation is greatly appreciated.

Appendix H: Sample SPO PC Software Requirements Model Survey

SYSTEM PROGRAM OFFICE (SPO) PC SOFTWARE

REQUIREMENTS MODEL SURVEY

THIS FIRST SECTION OF QUESTIONS (QUESTIONS 1 THROUGH 5) IDENTIFIES WHAT YOUR JOB IS AND WHAT DUTIES YOU PERFORM TO ACCOMPLISH THAT JOB.

1. What is your current <u>job title/position</u>?

   _____

2. What is your present <u>grade</u> or <u>rank</u>?

   _____

3. In which SPO functional department are you currently working? (circle letter)

   a. Project/Program Management
   b. Engineering
   c. Manufacturing/Quality Assurance
   d. Logistics
   e. Configuration Management
   f. Program Control

   g. Test Management
   h. Contract Management
   i. Data Management
   j. Procurement
   k. Other (specify) _____
      _____

4. What is your <u>primary</u> job responsibility within your department? Briefly explain.

   _____

   _____

   _____

5. What are the top two <u>specific</u> duties you perform to accomplish this primary responsibility? Briefly explain.

   (Example: Develop and write methods of test for inclusion in the Test & Evaluation Master Plan (TEMP))

   1. _____

      _____

   2. _____

      _____

QUESTIONS 6 THROUGH 14 ADDRESS YOUR USE OF <u>GOVERNMENT-OWNED</u> OFFICE PC SOFTWARE IN THE ACCOMPLISHMENT OF YOUR DUTIES.

6. Have either of the specific duties, identified in Question 5, been supported using PC software? (circle)

    a. Yes, both duties
    b. Yes, one of the duties (circle the number corresponding to the supported duty: 1   2)
    c. No, neither duty

7. Could a specific duty (identified in Question 5) which is currently <u>unsupported</u> be supported using PC software? (circle)

    a. Not Applicable, both duties are currently supported
    b. Yes, both duties could be supported
    c. Yes, one of the duties (circle the number corresponding to to the unsupported duty: 1   2)
    d. No
    e. Do Not Know

(If you do <u>not</u> currently use any PC software applications to support your job, please skip to Question 19.)

8. What PC software applications do you use for your job? (Circle all applicable.) Then for each application selected, approximate the number of hours <u>per</u> <u>week</u> you use the application. (Circle the appropriate range of hours.)

<u>Applications</u>		<u>Hours</u> <u>Used</u> <u>Per</u> <u>Week</u>				
a.	**Spreadsheets** (Ex: LOTUS 1-2-3, QUATTRO, etc.)	< 2	2-5	5-8	8-10	> 10
b.	**Word processors** (Ex: WORDSTAR, PEACHTEXT, etc.)	< 2	2-5	5-8	8-10	> 10
c.	**Graphics packages** (Ex: HARVARD GRAPHICS, CHART, etc.)	< 2	2-5	5-8	8-10	> 10
d.	**Programming languages** (Ex: BASIC, FORTRAN, etc.)	< 2	2-5	5-8	8-10	> 10
e.	**Decision support systems** (Ex: EXPERT CHOICE, DECISION AID, etc.)	< 2	2-5	5-8	8-10	> 10
f.	**Statistical packages** (Ex: BASS, POWERPACK, etc.)	< 2	2-5	5-8	8-10	> 10
g.	**Program management** (Ex: CAPPS, EXPERT SYSTEM, etc.)	< 2	2-5	5-8	8-10	> 10
h.	**Database management** (Ex: DBASE, CONDOR, etc.)	< 2	2-5	5-8	8-10	> 10
i.	**Integrated packages** (Ex: ABILITY, ENABLE, etc. which combine multiple applications)	< 2	2-5	5-8	8-10	> 10
j.	**Others** (specify) _____	< 2	2-5	5-8	8-10	> 10

Question **9** addresses the acquisition method used to obtain the applications used for your job. In answering this question, please refer to the following list of acquisition methods.

1. Standard small computer contract
2. Sole source or special purchase action
3. Contract negotiated by Small Computer Technical Center (SCTC)
4. Self-purchase
5. Other
6. Do not know

9. For each PC software application used, which acquisition method was used? (Circle the appropriate corresponding number.)

PC Software Application | Acquisition Method

a. Spreadsheet   1   2   3   4   5   6
(If "Other," specify _____)

b. Word processor   1   2   3   4   5   6
(If "Other," specify _____)

c. Graphics package   1   2   3   4   5   6
(If "Other," specify _____)

d. Programming language   1   2   3   4   5   6
(If "Other," specify _____)

e. Decision support system   1   2   3   4   5   6
(If "Other," specify _____)

f. Statistical package   1   2   3   4   5   6
(If "Other," specify _____)

g. Program management   1   2   3   4   5   6
(If "Other," specify _____)

h. Database management   1   2   3   4   5   6
(If "Other," specify _____)

i. Integrated package   1   2   3   4   5   6
(If "Other," specify _____)

j. Other (specify)   1   2   3   4   5   6

_____ _____

(If "Other," specify _____)

10. From the software inventory listed below, circle the letters
    corresponding to the specifically named products you use
    (IAW the applications selected in Question 8), and indicate
    for each whether you were involved in the procurement process for
    that software.

                        SOFTWARE INVENTORY

Spreadsheets Involved? (Yes/No)   Graphics Involved? (Yes/No)

a. LOTUS 1-2-3   a. CAD-3D
b. PEACHCALC   b. CHART
c. PERFECT CALC   c. GRAFTALK
d. QUATTRO   d. HARVARD GRAPHICS
e. SUPERCALC   e. SHOWMAKER
f. VP PLANNER   f. STATGRAPHICS
g. Other _____   g. Other _____

Word   Integrated
Processors Involved? (Yes/No)   Systems   Involved? (Yes/No)

a. MICROSOFT WORD   a. ABILITY
b. MULTIMATE   b. ENABLE
c. PC WRITE   c. Other _____
d. PEACHTEXT
e. VOLKSWRITER
f. WORDPERFECT   Decision Support
g. WORDSTAR   Systems   Involved? (Yes/No)
h. WRITE ONE
i. WRITESOFT   a. EXPERT CHOICE
j. Other _____   b. DECISION AID
                                      c. Other _____

Database   Program
Management Involved? (Yes/No)   Management Involved? (Yes/No)

a. CONDOR   a. EXPERT SYSTEM
b. DBASE   b. HARVARD TOTAL
c. DATAEASE   PROJECT MANAGER
d. HOMEBASE   c. PERT
e. MICROX   d. PMSS (CAPPS, CEM, etc.)
f. PARTS MASTER   e. SUPER PROJECT
g. PC FILE   EXPERT
h. Q&A   f. TIMELINE
i. Other _____   g. Other _____

            (List continues on next page.)

Statistical Packages	Involved? (Yes/No)	**Programming Languages**	Involved? (Yes/No)
a. BASS		a. ASSEMBLER	
b. MATHCAD		b. BASIC	
c. MICROSTAT		c. C	
d. POWERPACK		d. C-86	
e. QBS		e. COBOL	
f. Other _____		f. FORTRAN	
		g. GW BASIC	

Other (specify) Involved? (Yes/No)

h. MS FORTRAN
i. PASCAL

_____

j. TURBO PASCAL
k. Z-BASIC

_____

l. Other _____

For Question 11, please refer to the following task list.

a. Authoring
b. Decision-making
c. Diagnosis/Problem solving
d. Monitoring/Controlling

e. Organizing/Scheduling
f. Planning
g. Presentations (briefs)
h. Other (please specify)

11. For each PC software product specified in Question 10, provide
the generic task (using the letter(s) corresponding to the task(s)
listed above) and a brief specific description of the task(s)
it is used for.

Product Name   Task (ltr)   Task Description

(Example: DBASE   d. Monitor/control configuration item changes)

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

12. For each PC software product identified in Question 11, which has satisfactorily supported a task, briefly explain why you are satisfied with it.

      Product Name   Primary Reason(s) For Satisfaction

(Example: Chart   Flexibility in changing fonts and sizes to appeal to different audiences)

_____

_____

_____

_____

_____

_____

_____

13. For each PC software product identified in Question 11, which has not satisfactorily supported a task, briefly explain why you are dissatisfied with it.

      Product Name   Primary Reason(s) For Dissatisfaction

(Example: Expert Choice   Does not allow enough knowledge levels to support a thorough rationale for making a source selection decision

_____

_____

_____

_____

_____

_____

14. Based on your knowledge and experience, which two software products are the most useful to you? (Rank order by product name from list in Question 11.)

(1) _____

(2) _____

THIS NEXT GROUP OF QUESTIONS (QUESTIONS 15 THROUGH 18) ADDRESSES YOUR USE OF PERSONAL PC SOFTWARE TO SUPPORT YOUR JOB DUTIES.

15. Have you used (at work or at home) your own personal PC software to accomplish work-related tasks? (circle)

    a. Yes
    b. No

(If you answered "No" to Question 15, please skip to Question 19.)

16. Please list the product name(s) of the personal software used. (Example: QUATTRO)

    _____   _____

   .

17. Why were these tasks done using personal (non-government) PC software? (circle)

    a. Personal preference for an alternative software product
    b. Required software not available or not available in sufficient quantity
    c. Work at home requires compatible software
    d. Other (explain) _____

    _____

18. How often is this personal software used for your government office work? (circle)

    a. Daily   d. Bi-weekly   g. Other (specify)
    b. Almost daily   e. Monthly   _____
    c. Weekly   f. Quarterly

THIS FINAL SECTION OF QUESTIONS DEALS WITH THE WAY YOUR DEPARTMENT ACQUIRES PC SOFTWARE.

19. Is there a department policy (formal or informal) establishing a process or method to determine PC software requirements? (circle)

    a. Yes
    b. No
    c. Do Not Know

(If you answered "No" or "Do Not Know," to Question 19, you have completed the survey. THANK YOU FOR YOUR PARTICIPATION.)

20. What source(s) of guidance do you use when outlining PC
    software purchase requirements? (Circle all applicable.)

    a. Magazines   f. Other users
    b. AFR 700-3   g. Vendors
    c. AFR 700-26   h. Communication units
    d. AFP 700-30   i. Other (specify) _____
    e. Small Computer   _____
        Technical Center (SCTC)   j. None

21. Is the person who defines your PC software requirements a
    .designated computer resources representative? (circle)

    a. Yes
    b. No (Please specify this individual's position.) _____

    _____

    c. Do Not Know

22. Briefly describe the process your department uses to determine
    PC software purchase requirements.

    _____

    _____

    _____

    _____

    _____

    _____

    _____

    _____

23. How effective is this PC software procurement process in providing
    the correct or requested software? (circle)

    a. Highly effective
    b. Moderately effective
    c. Neither effective nor ineffective
    d. Somewhat ineffective
    e. Very ineffective

24. If you answered "d." or "e." to Question 23, briefly comment on the reason(s) for ineffectiveness.

_____

_____

_____

_____

25. How responsive (timely) is this procurement process in providing the correct or requested software? (circle)

   a.   Extremely responsive
   b.   Very responsive
   c.   Moderately responsive
   d.   Somewhat responsive
   e.   Not at all responsive

26. If you answered "d." or "e." to Question 25, briefly comment on the reason(s) for unresponsiveness.

_____

_____

_____

_____

27. Can you suggest an alternative process or ways to improve the current process of acquiring PC software? Please explain.

_____

_____

_____

_____

_____

_____

_____

THIS COMPLETES THE SURVEY.   THANK YOU FOR YOUR ASSISTANCE.

Appendix I: Comments/Suggestions of Survey Participants for Improving the PC Software Procurement Process

Comments/Suggestions

1. Four participants said designated computer representatives should be used to ask users what PC software they want and then recommend those products the SPO can afford.

2. One participant advocated just buying all of the products on the Standard Small Computer Contract.

3. Four respondents suggested computer users define their own needs, discuss the available known software, and then decide on the best available and purchase it.

4. Two individuals remarked users should establish their own requirements and submit a request to the CSRB.

5. One respondent said computers should be bought/issued with operating systems resident. Then allow users to request specific software to support requirements.

6. Three participants suggested mandating one word processor for Air Force and DoD-wide use.

7. Two respondents proposed using a base software organization that stocks required software for immediate delivery.

Alternate Requirements Determination Processes

1. (a) Increase visibility of the software requirements focal point.

    (b) Address user needs by tailoring requirements to satisfy office tasks.

    (c) Provide more training.

    (d) Supply a listing of available software to allow users to choose from.

2. (a) Set aside a budget for software.

   (b) Don't be concerned with word processing consistency within the SPO, just buy good, inexpensive conversion software utilities which will allow everyone to use what they are comfortable with.

   (c) Allow users to define their own requirements, and then submit requests to the SPO director for approval and purchase.

3. (a) Department computer representatives should interview department personnel to identify needs.

   (b) Obtain a list of requirements.

   (c) Have SPO computer representatives consolidate department needs with the rest of the SPO.

   (d) SPO representatives should confirm requirements with department representatives to assure consolidated requirements are valid.

   (e) SPO representatives submit requests to the CSRB.

4. (a) Have a committee of educated computer software personnel solicit requirements from SPO department personnel.

   (b) Conduct a series of studies to determine department current and future PC software requirements.

   (c) Procure software inline with study findings.

   (d) Provide adequate training support for initial and upgraded software purchases.

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aircraft until December 1985. He was then chosen to serve

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This study investigated the development of an alternative PC software requirements determination model for system program offices (SPOs) within Air Force Systems Command (AFSC) to perhaps improve the current software acquisition process. In developing this model an understanding of the present methods used to define personal computer (PC) software requirements, along with the current procurement methods employed were examined. The model is designed to match SPO mission objectives and functions with critical office tasks necessary to accomplish these objectives and functions. It then investigates/selects those PC software products which will best support the office task(s). Use of this alternative PC software requirements model should help SPOs better define, justify, and satisfy PC software requirements.

This study consisted of five research objectives:

1. Determination of the effectiveness of currently available PC software applications used to support SPO tasks.

2. Determination of current processes SPOs use to identify PC software requirements.

3. Determination of methods SPOs currently use to acquire PC software products.

4. Determination of the effectiveness of present PC software requirements identification and procurement practices.

5. Determination of whether development of a tailored PC software requirements model for SPOs might improve the PC software acquisition process.

The primary methodology employed a survey of 75 personnel assigned to five SPOs (one from each of the five product divisions) within AFSC. This survey explored PC software applications currently in use, how SPOs determine PC software requirements, how effective are current requirements determination methods, and how an alternative PC software requirements model might improve the current procurement process.

The Suggested or Alternative Requirements Determination Model provides a comprehensive methodology for assisting SPOs determine PC software requirements. Better requirements determination should make choosing the right software for the right job an easier task, thereby resulting in enhanced mission effectiveness.

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